JPRS-UCH-88-004
23 MARCH 1988

FOREIGN
BROADCAST
INFORMATION
SERVICE

JPRS Report

Science & Technology

USSR: Chemistry

Science & Technology
USSR: Chemistry

JPRS-UCH-88-004 23 MARCH 1988

CONTENTS

Petroleum and Coal Processing

Polymers and Rubber

Radiation Chemistry

Miscellaneous

UDC 534.6

Analysis of Kinetics of Formation of Ultrafine Particles in Supersonic Streams

18410474 Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 61, No 7, Jul 87 (manuscript received 9 Jun 86) pp 1971-1975

[Article by A.M. Lipanov, V.B. Fedorov, and P.V. Kalita, Moscow Institute of Chemical Machine Building]

[Abstract] To facilitate full scale usage of ultrafine particles (less than 10 nm), it is necessary to develop a new generation of engineering equipment and to expand research in this area. The most promising method appears to be recondensation. Equipment employing the principle of evaporation-condensation differs according to the methods of supplying the energy needed for evaporation, formulation, pressure, and temperature of the working mass, the system for collecting and separating the condensate, the organization of the condensation process, and other features. Organization of the condensation process appears to be the deciding stage in the preparation of ultrafine particles. The theoretical fundamentals of condensation kinetics are now sufficiently well known, and the process must apparently be conducted under strict non-equilibrium conditions where the rate of nucleus formation greatly exceeds particle growth rate and coagulation is reduced to a minimum. Previous work revealed several characteristics of a condensation process taking place in a stream of a vapor and a non-condensing gas mixture being cooled by expansion in a supersonic distillation unit. Thus, the change in temperature along the axis of the channel causes a growth in the degree of supersaturation of the vapor. This enhances the nucleation rate, and at a certain maximum degree of supersaturation, a marked increase in the condensate fraction takes place. Release of the heat of condensation causes a temperature rise, while the drop in vapor pressure, resulting from expansion of the mixture and elimination of the vapor phase at the condensation zone in conjunction with the rise in temperature, leads to a sharp drop in the degree of supersaturation. Formation of new particles under these conditions almost ceases, and condensation proceeds basically by growth of previously formed particles. Tungsten particles of 2-3 nm have been prepared. Analysis of the particle preparation process requires consideration of the relationship of the thermodynamic characteristics of the formed particles (especially surface tension) to the particles' size. In the present work, a theoretical model is presented for the formation of ultrafine particles in a supersonic stream. Figures 3; references 5 (Russian).

12765

UDC 532.5:541.182

Spatial Distribution of Dispersed Phase in Mechanically Forced Spray Jet

18410489 Ivanovo IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: KHIMIYA I KHIMICHESKAYA TEKHNOLOGIYA in Russian Vol 30, No 5, May 87 (manuscript received 12 Dec 85) pp 110-114

[Article by Yu.G. Zvezdin, N.N. Simakov, S.V. Seliverstov, V.A. Gorbunov, and B.N. Basargin, Yaroslav Polytechnic Institute]

[Abstract] Mechanical spray jets are frequently used in chemical processes to create a surface for interfacial contact in a liquid-gas system. The distribution J(r, z) of specific streams (spray density) and the distribution a(r, z) of the volumetric concentration of liquid as functions of spatial coordinates of points within a spray jet serve as characteristics of spatial distribution of the dispersed phase in a vertical, axially symmetric spray jet. For flow across a horizontally oriented plane, the axial velocity of the liquid $U_z(r, z)$ at a given point serves as a proportionality constant between J(r, z) and a(r, z), so that $J(r, z) = U_z a(r, z)$. In a hypothesis on linear movement of droplets in a spray-dispersed liquid, the normalized relationship of spray density to the dimensionless jet radius is progressive along the height of the latter. This served as a basis for proposing a method for calculating centifugal-stream jets by taking into account the required distribution of spray density across a jet cross section, specifically a spray jet providing a uniform distribution of liquid at any jet cross section. Proving the hypothesis on the linear droplet trajectory in a spray jet and the resulting proposal on the progression of the radial profile in a normalized spray density remain as problems. In the present work, results are presented on measuring spray densities and volumetric concentrations of liquid at various jet cross sections and various liquid spray pressures. The data obtained make it possible to conclude that the relative spray density profile changes with the height of the spray jet as a result of the curvature of the liquid particle trajectory induced by the injector gas. The feasibility of designing jets having uniform relative spray density profiles simultaneously at several jet cross sections is doubtful. Figures 4; references 6: Russian.

12765

Aerial Scattering of Reagent Disperses Fog at Moscow Airports

18410094 Moscow SOVETSKAYA ROSSIYA in Russian 23 Oct 87 p 5

[Article by N. Dombkovskiy]

[Excerpt] A difficult situation developed at Moscow's airports. A dense fog which had enveloped the runways was paralyzing air transport operations. The weather forecast was rather pessimistic, but civil-aviation personnel continued to seek a way out of the situation.

B.D. Grubiy, deputy head of the USSR Ministry of Civil Aviation's State Scientific Research Institute of Civil Aviation and a meritorious pilot of the USSR, related:

"Experiments with combating cloud cover and fog by the method of scattering special chemical reagents over them have been in progress in our country for a long time. We started thinking about them on those days.

"Shortly before 7:00 AM on 22 October, small openings appeared in the fog over Shermetyevo Airport, where some of our institute's airplanes are based. Two AN-12 airplanes carrying a reagent on board took off in succession at 6:54 AM and 6:57 AM. They were under the command of Fedotov and Sysoyev, two experienced pilots.

"A few dozen minutes later, these airplanes began scattering reagent above the runways of the Domodedovo and Vnukovo airports. The work was very difficult, but we accomplished our set task, although not completely, of course. A horizontal visibility of 900 meters was achieved at Domodedovo, and twice as much visibility at Vnukovo. This made it possible to receive 22 aircraft in Moscow in a brief period of time."

FTD/SNAP

/06091

Time-of-Flight Mass Spectrometry for Studying Pulsed Laser Action on Condensed Molecular Media

18410471 Moscow KHIMIYA VYSOKIKH ENERGIY in Russian Vol 21, No 4, Jul-Aug 87 (manuscript received 24 Jul 85) pp 361-366

[Article by Yu.A. Bykovskiy, M.M. Potapov, V.A. Ukraintsev, and A.A. Chistyakov, Moscow Engineering Physics Institute]

[Abstract] Laser action, combined with mass spectrometry, is widely used for elemental analysis of solids and the study of surface phenomena and laser stimulation of chemical reactions in the condensed phase. In the present work, a study was made of some features of the time-of-flight mass spectrometric method for studying pulsed decomposition of irradiated condensed molecular media (molecular crystals, polymers), using dinitrophenol as an example. Recording the scatter dynamics of products formed by this method enables one to study molecular fragmentation in an ionizer and to determine the surface temperature in the case of decomposition at a thermodynamic equilibrium. Figures 3; references 13: Russian.

12765

Mass Spectrometer Enters Series Production

18410130 Moscow FIRST RADIO PROGRAM MAYAK in Russian 1415 GMT 3 Dec 87

[Excerpts] Not long ago, Ukrainian scientists and designers showed their new developments at the USSR VDNKh. Our free-lance correspondent Yevgeniy Tsvetnov reports.

[Tsvetnov, voice] "Mass Spectrometer MS-7201M" is one of the exhibits that attracted the greatest number of visitors. It was manufactured by the Sumy "Electron" Scientific Production Association and was designed for determining the chemical composition of metal surfaces, semiconductors, and thin films. My guide Yuriy Bobrovskiy, an employee of the "Electron" Association, gave explanations:

[Bobrovskiy, voice] A sample semiconductor is introduced into the analytical chamber and is examined under a vacuum. The final result is displayed in digits on a computer or on a recorder in mass numbers.

[Tsvetnov] The mass spectrometer is already being used in Kiev, Tomsk, Ufa, and Odessa, as well as in some research institutes in Moscow. Full automation, efficiency, and a nearly absolute analytical precision are among the advantages of the instrument. And what else is important—each visitor is able to learn how to use it very quickly. A new modification of the instrument is being prepared for series production.

/06091

Varieties, Applications of Capillary Gas Chromatography

18410124c Moscow KHIMIYA: VYSOKOEFFEKTIVNAYA GAZOVAYA KHROMATOGRAFIYA in Russian No 10, Oct 87 pp 1, 2, 36-38, 41-43

[Table of contents, annotation, and excerpts from booklet by Viktor Grigoryevich Berezkin, "Khimiya: Vysokoeffketivnaya gazovaya khromatografiya" [Highly Effective Gas Chromatography], Moscow, Znaniye, 1987, 48 pp]

[Excerpts] Table of Contents (p 1)

Annotation (p 2)

Highly effective capillary gas chromatography is one of the most widely used analytical and physicochemical methods in scientific research and industry. The booklet discusses the specifics of the method, its theoretical foundations, the apparatus used, and basic variations of its practical application.

Excerpt from Chapter Titled "Methods of Work and Apparatus in Capillary Chromatography"

It is worthwhile to use capillary packed columns of high effectiveness both in laboratory and industrial chromatographs. The "Neftekhimavtomatika" Scientific Production Association of the USSR Ministry of Petroleum Refining and the Petrochemical Industry, with the participation of the USSR Academy of Sciences' Institute of Petrochemical Synthesis imeni A.V. Topchiyev, was the first in world practice to develop a miniature chromatograph of the new "Mikrokhrom" type, using capillary packed columns. These industrial chromatographs are successfully used to control processes in production of ethylene, styrene, divinylbenzene, and other large-tonnage products.

Capillary packed columns also have definite advantages in comparison with open capillary columns: 1) high individual effectiveness (up to 30,000 theoretical plates per meter of column length); 2) simple realization of gas adsorption chromatography; 3) reduced separation times due to high-speed mass exchange for small-diameter packing (of sorbents); 4) higher capacity of the column.

The USSR Academy of Sciences' Institute of Petrochemical Synthesis imeni A.V. Topchiyev recently proposed quartz micropacked gas-chromatographic capillary columns with high specific effectiveness (up to 30,000 theoretical plates per meter of length), which are distinguished by their convenience in use, the flexibility, inertness, and smoothness of the inside walls, and by high mechanical strength. For the first time, scientists studied the chromatographic characteristics of the new quartz capillary micropacked columns with a reduced diameter of sorbent grains (less than 30 micrometers). The columns studied are distinguished by their high specific effectiveness, high-speed separation, the relatively large quantity of sample they can analyze, and the ease with which they carry out well-known variations of gas chromatography.

But at the same time, packed capillary columns are characterized by a definite shortcoming — namely, high resistance to the carrier gas flow, which occurs when the columns are filled with fine-grain sorbent. In this case, chromatographs are used with the carrier gas under high pressure at the entry point.

Flexible and inert quartz micropacked columns are suitable for use in gas separation, in complex separations requiring the use of specifically selective solid adsorbents, and in making physicochemical measurements. As an example, we have produced a chromatogram for express separation of hydrocarbon gases and volatile hydrocarbons in a quartz-packed column.

The use of capillary micropacked columns in combination with open capillary columns is promising, as is the development of a special high-pressure gas chromatograph.

Excerpt from Chapter Titled "Practical Use of Capillary Gas Chromatography" (p 37)

Open capillary columns are also beginning to be used successfully for industrial control and regulation of technological processes, for example, for industrial control of gasoline quality. For this, a new type of industrial chromatograph has been used, which was developed by the "Neftekhimavtomatika" Scientific Production Association of the USSR Ministry of Petroleum Processing and the Petrochemical Industry: the Neftekhrom-1123, with what is known as blow-through explosion protection. Gasoline separation was carried out in a glass capillary column (45 m X 0.25 mm), with methyl silicon as the immobile liquid phase. During the course of analyzing the gasoline, the temperature of the column and the carrier gas speed were increased. Analyses can be carried out under fully automatic conditions. The economic effect of introducing a chromatographic control system into the operation of mixing stations amounts to 0.2 million rubles per year, mainly through reducing the net cost of producing goods.

The high effectiveness of open capillary columns makes it possible to carry out separations of compounds with very similar properties, for example, isotope-substituted compounds.

Methods of capillary pyrolytic (high-temperature) gas chromatography are used to study processes of thermal destruction and to assess the pyro- and thermo-stability of polymers. To solve these tasks and to determine the composition and structure of polymers, such methods are being used successfully, where volatile products are analyzed by gas chromatography and solids are characterized by the composition of the volatile products of their pyrolysis. Earlier, the opinion was expressed that it would be promising to carry out pyrolysis under conditions of programmed temperature increase. Now this method has practically been realized by the Estonian SSR Academy of Sciences' Institute of Chemistry.

The two-dimensional form of presenting experimental data is very descriptive and enables one to make a rapid qualitative assessment of the pattern being analyzed.

Thus, among the products of polyvinylchloride pyrolysis, two main ones are present: the larger peak is benzene, and the smaller is toluene. The method of high-speed gas pyrolytic chromatography makes it possible to obtain a large amount of primary information during the course of a single experiment and makes it theoretically possible to determine the kinetic characteristics of the pyrolysis reaction.

Among the many important fields of practical application of gas chromatography, biochemistry must be mentioned. As an example, let us cite the use of capillary chromatography for identification of bacteria. As is well known, lipids and their derivatives play an important role in the vital processes of microorganisms. Study of the fatty-acid composition of bacteria has proved that the qualitative composition of organic acids is characteristic for many species of bacteria, and this rule may be used to identify them, and although various species of bacteria characteristically contain a broad spectrum of unsaturated fatty acids with 16 carbon atoms, a detailed analysis of the isomers makes it possible to distinguish these species. The feasibility of classifying bacteria according to their chemical composition is expanding substantially, specifically due to the use of capillary chromatography, which is characterized by a high-resolution capacity and relatively simple apparatus. A great contribution to developing this interesting field has been made by scientists of the USSR Academy of Sciences' Institute of Biochemistry and Physiology of Microorganisms.

In current chromatographic practice, advantageous use is being made of open quartz capillary columns. The Scientific-Research Institute of Electro-vacuum Glass, the USSR Academy of Sciences' Institute of Petrochemical Synthesis, and the Scientific-Research Institute of Plastics have developed the first Soviet technology for obtaining open quartz capillary columns. The Soviet quartz columns are not inferior in properties to the best capillary columns produced by foreign firms in Australia, Finland, and the United States. As an example, one might cite a chromatogram for separation of diesel fuel, in which the N-alkane peaks, the pristane and phytane peaks, are labeled, and the total number of satisfactorily separated peaks is over 400.

12255

Brief History of Soviet Backwardness in NMR Research, Instrumentation

18410124a Moscow KHIMIYA I ZHIZN in Russian No 10, Oct 87 pp 6-14

[Excerpt (pp 13-14) from article by Doctor of Physical-Mathematical Sciences E.I. Fedin, chairman of the USSR Academy of Sciences Commission on Radiospectroscopy for Chemical and Biological Research, under rubric "Problems and Methods of Modern Science": "Nuclear Magnetic Resonance: The Newly Acknowledged Necessity, or, Talents Buried in the Earth"]

[Excerpt] Afterword, Special Section

"Full-fledged development of modern chemistry without NMR-spectroscopy is impossible," said Academician A.N. Nesmeyanov. Unfortunately, in his time this opinion of the authoritative gentleman did not have an effect on the situation in our instrument building. The surprising history of the refusal to issue an inventor's certificate to Lt. V.A. Ivanov, who got the idea for NMR-tomography as early as 1960, has already been written about in newspapers and the journal IZOBRETATEL I RATSIONALIZATOR.

In 1967, the RYa-2305 spectrometer was compared to a similar instrument, "Bruker," which had appeared at that time. The president of the Perkin-Elmer firm came to us at that time with proposals to produce NMR-spectrometers jointly. The proposal was rejected.

In the 1970's, similar proposals were made by the Bruker firm. No attention was paid to them.

In 1978, Andrew showed us an NMR-tomogram of the wrist. In 1980, the All-Union Scientific-Research Institute of the Cable Industry, of the Ministry of the Electrical Equipment Industry, came to the Commission for Radiospectroscopy for help in launching projects on NMR-tomography. The help was given. At the Elektro-82 Exposition, there was a showing of a Soviet NMR-tomograph for biological research, on whose screen was shone a cross-section of an olive tree. To this day, this instrument has not been manufactured in series production (the production of an NMR-tomograph for the human head, developed by the All-Union Scientific-Research Institute of the Cable Industry, has already been postponed twice. This time—to 1988. The design is becoming outdated, but the Ministry of the Electrical Equipment Industry is in no hurry...).

In 1982, M.S. Shkabardnya, head of the Ministry of Instrument Building, noting the grave situation with NMR-apparatus, gave the order to transfer series production of it from the Smolensk Analitpribor Plant to the Lvov Mikropribor Plant, which has not produced a single such instrument in the past 5 years. Since 1983, NMR-spectrometers have not been manufactured at all in our country.

A succession of names and events passed before the reader. One and the same history was repeated with a depressing regularity: colleagues abroad achieved success after success, while Soviet researchers, bursting forward at isolated moments, suffered one dashed hope after another: our instrument building drove them off as incense does an unclean power.... Soviet specialists in the field of magnetic resonance are not guilty before the country. Who is guilty? How can the situation be corrected? Let us think together. After all, an NMR-spectrometer is just as necessary to the chemist as a hammer is to a sculptor or a balalaika is to a soloist in the Orchestra imeni Osipov. About the NMR-tomograph, I will not repeat myself: all of us, chemists and bus drivers, sculptors and lathe operators, musicians and plow operators, when we are sick, require an error-free diagnosis.

This constitutes the basic significance of the title of my article. What will develop in foreign NMR, of course, will be interesting and significant. But what will happen with Soviet NMR?

12255

Moscow Dispatching Office Coordinates Sales/Purchases of Second-Hand Instruments

18410124b Moscow KHIMIYA I ZHIZN in Russian No 10, Oct 87 p 53

[Unattributed article: "Moscow, 112-44-60"]

[Text] If your organization wishes to get rid of unneeded instruments or acquire necessary instruments quickly and with minimal effort, you should call telephone

number 112-44-60 between 3 and 6 PM and give the following information to the dispatcher of the Moscow City Main Administration of Material and Technical Supply:

—the number of the official telephone from which you are providing information;

—your full name;

—"selling" or "buying;"

—name and type of the instrument;

—percent of serviceability of the instrument (approximately).

The dispatcher will inform you of the coordinates of an interested party there and then and will not participate in the future act of buying or selling.

The information given on the telephone should be thoroughly thought out in advance and should not take up more than 2 minutes. The dispatcher also answers long-distance calls. Please send all suggestions, requests, and lists of instruments (more than three) by mail to this address: 115446, Moscow, Kolomenskiy Proyuzd, Block 1, Building 1, Dispatcher for Instruments.

First, the dispatcher provides and receives information on optical linear-angular measuring instruments, lasers, and other optical control-measuring instruments costing over 500 rubles.

Upon receiving an instrument, a buyer is obligated to inform the dispatcher by postcard on the very same day. The text of the information snould run approximately as follows: "Have obtained large projector of type BP, Zav. No [possibly factory number] 68042, price 850 rubles, purchaser's telephone number 139-13-54, Alekseyev, P.I., signature, date."

12255

Discovery of Chemical Reaction Inhibitors

18410098 Moscow MOSCOW NEWS in English 4-11 Oct 87 p 10

[Article by Ilya Vais]

[Text] Discovery Number 338 has been entered into the USSR State Register of Discoveries. Its authors are scientists from the Institute of Chemical Physics of the USSR Academy of Sciences.

The idea of the need for a kinetic approach to the phenomenon being studied, which belongs to Academician Nikolai Semyonov and one of the authors of the discovery, the late Academician Nikolai Emanuel, is applicable not only in chemistry. After all, the kinetic approach is a study of a reaction in time, and this principle helps to understand much in life as well.

The origins of the just-registered discovery can be traced to the distant year 1943, when Emanuel's tiny laboratory started working after being evacuated to Kazan. The laboratory's personnel consisted on only a few, but they included the then quite young pupil of its head, Erna Blyumberg, now a Doctor of Chemical Sciences and a Professor, who is the second author of the discovery. The origins lie in the works of Academician Nikolai Semyonov, a Nobel laureate, who saw Emanuel as perhaps the most creative-minded and talented of his pupils. After all, it was Semyonov who discovered a totally new class of chain reactions, the so-called branched-chain reactions, and they became the root cause of the current event. The sources lie also in the relatively recent time when Erna Blyumberg acquired talented pupils, Sergei Maslov and Levon Tavadyan, who came from Armenia to the postgraduate course at the Institute of Chemical Physics. Those two completed the formation of a "team" of trailblazers.

The official formulation of the discovery — "the phenomenon of selective inhibition of many-centered chemical reactions" — stands to offer not only a new building block for fundamental science, but also new potential for applied science, production, the economy, and ecology. The point is that chain reactions lie at the bedrock of many important technological processes. These reactions occur through the interaction of molecules with so-called active centers — radicals. But when instead of one active center, two or several originate in the system, every one of them can lead its own independent chain process. The result is the formation — besides products for whose sake the reaction is conducted — of other products which are often totally unnecessary and ecologically harmful. So far, it has been known that the activities of additional centers could be cut short by introducing special substances — inhibitors — into the reaction. But then the whole process was brought to a halt.

However, no one was able to halt the entire reaction, only part of it — that which, in the given case, was undesirable for research or production. Only one direction of the process was inhibited without affecting all the rest. The body of authors at the Institute of Chemical Physics discovered this method, which boils down to the substance of the discovery.

What sectors of the economy can profit from the new method? The petrochemical industry (the efficiency of transforming costly raw materials in short supply into valuable organic synthesis products will more than double), the polymer industry, and the perfume industry. Technological processes which have so far been inaccessible are becoming possible: they are cheaper than the old ones, more productive, and, besides this, practically wasteless and hence ecologically harmless.

/06091

Specialization, Cooperation in Chemistry among CEMA Countries

18410065 Moscow FOREIGN TRADE in English No 9, Sep 87 pp 6-10

[Article by Natalia Sterlina, Candidate of Economic Sciences]

[Text] The large diversified chemical complex of the Soviet Union with its strong energy, raw material, scientific, and technical base predetermines the leading role the USSR plays in the CEMA countries' chemical industry. In 1985, our country accounted for the following percentage of the total CEMA countries' production of certain chemicals: mineral fertilizers, 70.6; methanol, 74.4; ammonia, 68.8; paints and varnishes, 65.5; chemical fibers and threads, 55; and plastics and synthetic resins, 49.3. Substantial export producing capacities in many lines of manufacture have made the USSR the largest world exporter of ammonia. The percentage of its exports in world sales is the following: industrial carbon, nearly 20; methanol, 17; synthetic rubber and vinylchloride, almost 10.

These achievements are largely due to the CEMA countries' international division of labor and the expanding socialist economic integration in chemistry.

Results and Methods of Specialized Production

Nearly half of the Soviet foreign trade turnover in chemicals, fertilizers, and rubber (46.3% in 1985) is with the socialist countries. In the last Five-Year Plan period, the export of chemicals to the socialist countries was very dynamic; its increase amounted to 78.7%, which exceeds the total Soviet export growth to these countries (64.6%).

This substantial increase is due to deliveries under agreements on international specialized and cooperative production (ISCP) with the CEMA countries. Over the past five years, the volume of such deliveries increased 2.6 times. Although in 1985, the share of these deliveries as part of the entire amount of chemicals exported to CEMA countries was not yet very large (only 18.6%), they comprised 30.2% of the CEMA countries' total mutual exchange of specialized chemical products. The bulk of Soviet specialized deliveries went to Hungary, Czechoslovakia, the GDR, and Poland. The Soviet Union exported specialized chemical products under 12 multilateral and 34 bilateral ISCP agreements. At the same time, in 1985, each European CEMA country exported from 45 to 80% of its specialized chemical products to the Soviet Union.

International specialization gives the partner-countries vast prospects for developing highly efficient optimal manufacturing capacities for redistributing capital investments in the chemical complex to ensure a more rational pattern of each nation's economic production and for securing stable supplies of imported chemicals. Soviet-Bulgarian specialization in the production of medicines, for example, has enabled Bulgaria to reorganize its pharmaceutical industry more rationally, to cease producing ineffective products, and to set up other large, more profitable enterprises that mass-produce medicines. For instance, Bulgaria no longer makes pyramidon, of which it has a stable supply from the Soviet Union, but has started large-scale production of analgesic preparations instead, which it exports to the Soviet Union.

The ISCP now underlies the so-called selective structural policy of many European CEMA countries, i.e., priority development of selected interrelated lines of manufacturing instead of the widespread diversification of chemical complexes practiced earlier. As a result, in 1981-1985, 81.6% of total Soviet calcinated soda imports (96.3% from CEMA countries) came from Bulgaria, and 25.8% of all imported paints and varnishes came from Poland.

Ammonia, methanol, fertilizers and some large-tonnage plastics make up the basis of Soviet deliveries under specialization. As much as 62.9% of its exports of potash fertilizers goes to the CEMA countries in an amount equal to 35% of their total production in the USSR.

Long-standing trade turnovers and the ISCP have predetermined the specializing status of each CEMA country in the mutual relationships. The Soviet Union mainly supplies mined raw chemical materials, mineral fertilizers, and other large-tonnage and material-intensive products, while the other European CEMA countries are exporters of small-tonnage products. As a matter of fact, such specialization now forms a highly developed system of the intersectoral division of labor, bearing in mind that the chemical industry is a multi-sectoral complex. The motivation for such labor division stems from the fact that while the Soviet Union has vast resources of raw chemicals, the European CEMA nations' export resources can only concern small-tonnage products. The small consumption volumes of individual countries, the wide assortment and lower material and energy intensities as compared to other chemical enterprises, and the higher labor input (mostly of skilled labor) have made these products most suitable for further development by the European CEMA countries.

This model of cooperation was given another impetus by the signing (1979) and subsequent implementation of multilateral and corresponding bilateral agreements between the USSR and each CEMA country on specialized and cooperative manufacture of energy-intensive and less energy-intensive chemical products. Under these agreements, the energy- and material-intensive manufacturing facilities were to be constructed near the energy and raw material sources (i.e., in the Soviet Union), whereas the less energy- and material-intensive manufacturing capacities were to be developed in those CEMA countries where the resources of raw materials and energy were limited. To supply the required

amounts of energy-intensive products, from 1981-1985, the Soviet Union had to put additional capacities into operation to produce ammonia, methanol, carbamide, low-pressure polyethylene, and polyvinylchloride and raise the production of potash fertilizers. The above-mentioned substantial increase in Soviet exports of specialized chemical products to the CEMA countries is largely due to these sources. The European CEMA countries also put up new and have expanded existing installations to make protective chemicals for plants (Hungary), chemical additives (the GDR, Czechoslovakia), etc.

Realization of these agreements positively raised the effectiveness of each CEMA country's economy in terms of the manufacture and use of chemical products. For example, Czechoslovak specialists point out that the agreement on specialized energy-intensive products with the Soviet Union has enabled Czechoslovakia to reduce electricity consumption, ensure steady sales of its synthetic rubber and plastics, and expand its exports of medicines and chemical and biochemical compounds for agriculture to the Soviet Union. At the same time, the agreement helps meet the Soviet Union's needs for certain chemicals.

As a matter of fact, the Soviet-Hungarian agreement on cooperation in agro-chemistry, considered to be very effective, has also an intersectoral nature. Under this agreement, Hungary took the commitment to deliver ten types of protective chemicals for plants to the Soviet Union during the period ending in 1990. The Soviet Union reciprocated by supplying two types of mineral fertilizers, six kinds of petrochemical products, eight species of intermediate products, and four types of pesticides. From 1981-1985, the mutual sales under this agreement exceeded 1,000 million rubles. They are expected to be 1.5 times greater in the current quinquennium.

This agreement "enables Hungary to develop up-to-date optimized manufacturing capacities for chemicals for plant protection.... Furthermore, realization of these agreements (this agreement and the other one on energy-intensive products—N.S.) improves Hungary's national economic balance of payments. Under these agreements, Hungary receives chemical products which it does not manufacture and would have to purchase with hard currency. On the other hand, the Soviet chemical industry can spend less on production of chemicals for plant protection and more on the manufacture of basic and intermediate products" (Footnote 1, G. Sekeres, "The Production of Chemicals for Plant Protection in Hungary," CEMA Countries' Economic Cooperation, No 8, 1986, p 43).

In the past five years, the Soviet Union and the other CEMA countries began to specialize in the manufacture of new products. ISCP agreements were signed on several types of chemical fibers, rubber products, and chemical products for microelectronics, envisaging mutual exchanges of particular products or combinations of them. These agreements added to the already existing series of multilateral ISCP agreements signed in the early 1980s (on pharmaceutical products, synthetic dyes, chemical and biochemical additives to feeds, chemicals for plant protection, etc.), which were conducive to expanding the intersectoral exchange of chemical products.

However, it seems that reserves for the further expansion of intersectoral specialization are, for the most part, exhausted, as the bulk of new chemical products required by all CEMA countries cannot be effectively supplied by one country. Obviously this explains "the yet slow progress in specialized production of raw materials, intermediate and auxiliary products, chemical agents, catalysts, etc. All CEMA member-countries still have deficits of some kinds of chemical products, including specialized ones" (Footnote 2, N. Titov, "International Specialization in Chemistry," CEMA Countries' Economic Cooperation, No 6, 1984, p 51: Speaking of raw materials and intermediate products, N. Titov had in mind the fact that, generally, no specialized multilateral agreements have been signed on them; however, they do comprise an essential "specialized" part of Soviet chemical exports to the CEMA countries—N.S.).

Cooperation in Chemistry

The first step towards making new chemical products is production cooperation. A good example of such cooperation between the USSR and the European CEMA countries is the Soviet-Hungarian agreement on cooperative production of olefins and the by-products of their processing. At present, the ethylene produced at a Hungarian petrochemical plant is pipelined to a Soviet reprocessing complex to be manufactured, together with the propylene from Hungary, mostly into plastics, part of which are shipped back as payment for the olefins. Such cooperation reduces each country's investments in building a full-scale petrochemical complex and promptly satisfies both countries' increasing requirements for polymer materials.

The growing demand for the olefin derivatives requires radical changes in the Soviet-Hungarian cooperative partnership. In 1987, a new shop for making olefins will be opened in the Soviet "Chlorvinyl" Production Association in Kalush to supply 60,000 tons of ethylene to Hungary. The Hungarian enterprise in Leninvaros will use new unique facilities to reprocess 130,000 tons of its own and the 60,000 tons of Soviet-supplied ethylene into linear polyethylene of low (copolymer) and high density. Concurrently, 25,000 tons of polypropylene for fiber production will be made annually for delivery to the Soviet Union. The example cited illustrates that mutual exchanges of products within the framework of cooperation permit not only variations in labor division, but also allow for prompt and flexible responses to the changing demand.

However, the potential for production cooperation between the Soviet Union and other CEMA countries has not yet been used to the full. Moreover, as new chemical products are constantly in demand, production cooperation has to be combined with scientific and technical cooperation.

For example, the CEMA countries' needs are far from being satisfied in science-intensive, small-tonnage chemicals which are technologically difficult to produce and frequently require the concurrent manufacturing of intermediates. Their industrial development is too much for one country to tackle alone, as it requires a corresponding scientific and technical base and sometimes special auxiliary capacities to produce intermediate products. Sometimes countries prefer this method as it creates reliable resources for producing competitive exports, as, for instance, Hungary, which carries out its centralized development program on the manufacture of medicines, chemicals for plant protection, and the corresponding manufacture of intermediates.

At the same time, the production of new small-tonnage chemicals could be greatly accelerated if intrasectoral scientific and technical cooperation were made the underlying concept. Then, maximum utilization of the full potential of each country would be given preference. This means that one country could make its scientific results available to others, another could develop the technology (probably jointly with the first), while the third could supply the equipment, the fourth — be in charge of auxiliary and raw materials, etc. In short, such cooperation could help countries with marginal or yet unrealized opportunities to participate in developing and producing new enterprises.

This model has many advantages for the European CEMA countries. It would enable them to make full use of idling capacities, concentrate and orient their scientific potential to accomplishing priority tasks, develop a common intermediate product base for industrial manufacture of a series of related products in individual countries, etc. What is most important, however, is that the partners would have broader access to each other's scientific achievements in chemistry and could jointly make quicker progress in developing new products and technologies and produce the former on a mass industrial scale.

This approach is characteristic of the world-famous Hungarian chemical plant Gedeon Richter which studies data on new products in the socialist countries (including the experience of the Institute of Pharmacology of the USSR Academy of Medical Sciences) and develops industrial techniques for their manufacture and, subsequently, new and more effective medicines.

The European CEMA countries are interested in the greater use of Soviet scientific and technical results in chemistry, which is quite natural, as they cannot afford the "luxury" of having a wide network of academic and sectoral institutes in all fields of chemical R&D. L. Papp, Deputy Chairman of Hungary's State Committee for Technological Development, in an interview granted to the NEPSZABADSAG paper, pointed out that due to cooperation, Hungary was able to obtain knowledge that would be hard to get in other circumstances and at a much slower rate (Footnote 3, from the CEMA countries' press. "An Informative Review." CEMA, No 20, 1986, p 7). This specifically refers to new materials and their manufacturing technologies and treatment. Soviet-Hungarian scientific and technical cooperation in new fields has already yielded useful results for both countries: in the past Five-Year Plan, their enterprises concentrated on expanding the assortment of chemical agents and super-pure compounds; they developed 26 new technologies, 14 of which make it possible to cancel imports from the capitalist countries (Footnote 4, Ibid.).

Prerequisites for expanded scientific and technical cooperation in fields where CEMA countries have to jointly breach the "wall of deficits" and ensure adequate supplies of required chemicals for the national economy have been created thanks to the correlation between prospective restructuring of the Soviet chemical complex and priority tasks of cooperation with each CEMA country. These tasks were formulated and incorporated into long-term bilateral programs of economic, scientific, and technical cooperation in the chemical industry that run up to the year 2000. Here are some of the tasks. Soviet-Bulgarian cooperation concentrates on problems whose solution will help supply both countries' national economies with progressive structural plastics for the engineering and electronic industries, highly effective catalysts and secondary polymer materials from rubber and plastic wastes, etc. The Soviet-Polish program envisages joint efforts in developing new progressive types of structural plastics, chemical and biochemical additives to feeds, preservatives, and some agents for plant protection. The Soviet-Czechoslovak project centers on greater specialization in science and research and in the production of certain pesticides, dyes, catalysts, chemical fibers, special structural plastics, super-pure materials for electronics, etc.

In accordance with documents of the fraternal parties' recent congresses, these guidelines form the priority tasks for developing the European CEMA countries' chemical industry for the current Five-Year Plan period and subsequently up to the year 2000. All are new from the point of view of technology and manufacturing, and scientific and production cooperation is the only way to cope with them.

Transition to the "Technological" Model of Cooperation

Gradually, as the CEMA countries' chemical industry changes over to intensive development, to increased production of mostly new products coming from the latest technologies and technical solutions, the intersectoral model of cooperation, although still keeping its former status, will be losing way to the new technological

model whose aim is to raise the technological and technical levels of production and launch the mass production of new chemicals. The cooperation will be basically scientific and industrial.

The technological cooperation model is basic to every project concerning the chemical industry in the Comprehensive Program for Scientific and Technological Progress (CP STP). For example, the Biotechnology Section provides for development, through joint efforts of the Soviet Union, Czechoslovakia, Hungary, and the GDR, of nearly 300 chemical agents by heightening the scientific level and reducing the time for research in genetic engineering, biology, and biochemistry. The Electronization of the National Economy Section stipulates the development of technologies and equipment necessary for producing 20 super-pure compounds for microelectronics.

Chemistry is predominant in the New Materials, their Manufacturing and Treatment Technologies Section. Joint activities are concentrated here on the development and production of structural polymer materials and the development of new processing technologies for plastics. The production of plastics in CEMA countries as a whole, and the Soviet Union in particular, is not meeting the growing demand. In the past five years, the CEMA community accounted only for 12% of world production, whereas CEMA total chemical production stood at roughly 30%. The main problem in developing the plastics industry is to update and expand production because at the end of the past Five-Year Plan period, the share of most progressive polymerized plastics in CEMA countries amounted only to 46.1%; in the Soviet Union, it was 39%. The purpose of the CP STP is to solve this problem. Then the share is expected to rise to 54.9% by the time the year 2000 arrives.

The need to make new plastics for engineering and technical purposes is very urgent. This field has absolute priority in the CP STP. The Soviet Scientific Production Association (NPO) "Plastmassy" has been appointed head organization for the sector. The cooperation program on this problem was the logical result of previous cooperation in this sector, especially with the GDR. The "Plastmassy" NPO has been cooperating with the Bunawerke enterprise in manufacturing polybutyleneterephtalate since 1979. German engineers have developed catalysts and some types of equipment, whereas Soviet specialists have performed R&D on the technology and produced remaining equipment items. In the current Five-Year Plan period, the results will be used to modernize industrial production in the Soviet Union and the GDR. The economic advantages of the joint venture will be that the R&D deadlines will be reduced by roughly twelve to eighteen months, and hard currency will no longer be spent on such imports from Western countries.

For the time being, this is only a phase in scientific and technical cooperation, not yet cooperative production; therefore, it is too early to speak of the results from concentrated manufacturing or from saved investments. However, the situation will soon change as every new developed polymer will be immediately put into mass production.

The Soviet NPO "Plastik" is also a head organization handling another vital problem — the development and introduction of automated methods for manufacturing and designing products from polymer materials. The basic form of cooperation here will be joint, contract-based R&D, also involving organizations and enterprises in Bulgaria, the GDR, and Romania.

Here are some of the planned joint projects. The Bulgarian "Techmet" NPO, along with "Plastik," will be developing cast and pressed forms of standardized components and units. A consolidated catalog of standardized components is to be compiled and printed this year. The GDR Plast-Elast Verarbeitung complex, the Bulgarian DSPIE (in the town of Kyrjali), and the Soviet "ENIMS" NPO and Gosplastproyekt Institute will be undertaking R&D and putting into production an automated modular complex for making fittings. The expected results from this cooperation will be: the preparation-for-production time will be from two to five times less; the labor intensity of mechanical processing will be reduced two to three times, and labor productivity will rise five to six times.

That it is high time to formulate and adopt decisions on cooperation for realizing the Comprehensive Program in this area can be seen from the fact that the initiatives are coming from the working links, i.e., from the CEMA countries' economic organizations and enterprises. For example, competent Soviet authorities are now examining the proposal of the Bulgarian firm Ipoma, concerning the establishment of a joint Soviet-Bulgarian amalgamation to produce plastic products. The G. Dimitrov Chemical Complex in Bratislava has displayed interest in cooperation with its corresponding Soviet NPO in improving the manufacture of super-pure chemicals for electrical enterprises.

Much has to be done (predominantly on the basis of technological cooperation) not only in the directions outlined by the CEMA CP STP, but also in small-tonnage production lines, which will fill the needs of the chemical complex itself for such products as chemical additives, catalysts, and auxiliary compounds. A lag in these matters costs much both in the ordinary sense of the word, as the world prices for such products are very high, and figuratively speaking, as no high-quality chemicals can be produced without such additives.

A start on cooperation in these areas has been made. In the Soviet Union, much attention is being paid to the development, production, and application of new catalysts, since today, 80-85% of all technological processes in the chemical industry are based on their use. In the current Five-Year Plan period, it is envisaged to renew 40-50% of industrial catalysts in the Soviet Union and

place reliance on more selective ones. New catalysts are expected to be used in all processes needing them by 1995. Large-scale research in this area is under way in the CEMA countries. In cooperation with the Catalysis Institute of the Siberian Department of the USSR Academy of Sciences, CEMA specialists have worked out (within the framework of the Coordination Center on Catalysts) measures to improve catalysts and set up their experimental industrial production in a number of countries. At the end of the past five-year period, the CEMA countries concluded an agreement on the joint construction of catalyst-making capacities.

Headway has been made in the cooperative development and production of chemical additives by the Soviet Union and Czechoslovakia. Soviet and Czechoslovak chemical engineers have jointly developed progressive technology for a new preparation, Antioxidant CD, for the rubber industry. The Czechoslovak Duslo-Sala enterprise has built one of the world's largest installations (rated capacity of 12,000 tons per year) to make this substance. Nearly 80% of the product will be delivered to the CEMA countries, including the Soviet Union, whose share will be the largest as it supplies, within the cooperation framework, the intermediate product for this undertaking. This cooperation project has enabled the CEMA countries to more rationally use their technological potential, save investments on their own production of this additive, and cease imports from Western countries.

Unfortunately, such examples where the partners in technology development also cooperate in manufacturing and fully supply their countries' needs are still not numerous. This situation will continue until full coordination is achieved of the interests of research organizations and those of industrial enterprises, on the one hand, and the interests of industrial enterprises and those of foreign trade associations, on the other. An organizational restructuring in the foreign economic sphere is now fully under way in the Soviet Union. Many large chemical NPOs with competent scientific and technological subdivisions have been granted the right to establish direct ties with their CEMA partners.

Now joint ventures are being set up more and more. For instance, the Soviet Union and Poland have signed an intergovernmental agreement on establishing a joint venture to make household chemicals, using the Pollena-Miraculum Plant in Krakow as a base facility; under scrutiny are also questions on setting up Polish and Soviet enterprise coordination-production amalgamations in the photochemical industry and in the dye and plant protection chemical sectors.

Wide vistas have opened up for scientific and production cooperation that is based on direct links and joint ventures which will transform the projects envisaged in the CEMA CP STP into reality. This concerns, above all, the production of new materials, chemical additives, and compounds for the electronic, rubber, and food industries and biochemicals for agriculture, packing materials, etc.

Thus, the need for the quickest possible industrial manufacture of new chemical materials, substances, and technologies, as well as for new, more favorable organizational conditions, supporting direct cooperative ties, has made the "technological" model of cooperation first priority for the future.

/06091

UDC 541.124

Integral Doppler Anemometry in Longitudnal and Transverse Focused Force Field

18410473 Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 61, No 7, Jul 87 (manuscript received 8 Jul 86) pp 1947-1949

[Article by S.N. Semenov and V.L. Kononenko, Institute of Chemical Physics, USSR Academy of Sciences, Moscow]

[Abstract] A previously proposed method of integral doppler anemometry is based on recording doppler shifts in the frequency of laser radiation scattering simultaneously along the entire cross section of a channel in which laminar flow of a liquid-carrier occurs and in which a transverse non-uniformity in concentration of scattering particles in the flow is somehow created. Under such conditions, the shape of the integral doppler spectrum is directly related to the transverse distribution in concentration of the scattering particles, thereby making it possible to determine this distribution experimentally. One possible application of this method is in studying polydispersed systems. In this case, since the recorded spectrum consists of superimposed individual fractions, it is desirable to select a cross section force field profile in which the concentration of individual fractions would differ to the greatest extent. This situation is realized when a force acts across a channel which focuses various types of particles at various points of its cross section. Since the laminar flow velocities at these points differ, each fraction will correspond to its doppler peak in the scattering spectrum. This kind of focused integral doppler anemometry could be achieved by various means, such as with the aid of centrifugal force and a density gradient, or by a transverse differential in potentials and pH gradients. The conditions needed for focusing have been developed successfully for applications in biological research. In the present work, the shape of the transverse integral flow of the doppler spectrum of laser radiation, scattered by a system of small particles, which move in a laminar flow and in the presence of a transverse force field, which focuses these particles in predetermined areas of the cross section, has been computed, and the possibility of analytically fractionating the particles according to the shape of their doppler spectra is discussed. References 4: 2 Russian, 2 Western.

12765

UDC 533.9:621.793

Plasmodynamic Problems of Dispersed Jet Systems: Modern Computerized Physics Experiment

18410486b Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA TEKHNICHESKIYE NAUKI in Russian No 3, May-Jun 87 (manuscript received 25 Dec 86) pp 69-86

[Article by M.F. Zhukov and O.P. Solonenko, Institute of Thermal Physics, Siberian Department of the USSR Academy of Sciences, Novosibirsk]

[Abstract] Judging from the new generation of plasma equipment (for handling powdered materials of complex chemical composition in high temperature jets, such as for applying coatings), incorporating computerized systems for controlling and stabilizing process parameters which have appeared in the foreign literature over the past 5-7 years and the improvement in product quality and range of materials handled, fundamental research at US, French, Canadian, Japanese, and other scientific centers on plasma dynamics of dispersed jet systems has expanded for the purpose of studying both the feasibility of processing powdered materials in plasma-engineering systems and the application of results to specific technologies. An acute need for conducting similar research in the USSR has also become apparent, especially since plasma engineering has been included in the list of high priority items in the development of the national economies of the USSR and CEMA countries. Recently, a need arose for conducting research at a new level, based on the development of automated scientific research systems which incorporate an automated experimental research system on the plasma dynamics of dispersed jet systems. This is needed for both the internal logic of developing high temperature gas dynamics of multiphase systems and for applied problems related to expansion in applications of plasma treatment of dispersed materials, which is currently being held back by the low level of plasma equipment automation. This frequently precludes adding such essential requirements as repeatability and process control. This is especially the case with powdered material dusting, where the coating material is atomized from a wire in a high temperature gas jet and transported to a base with which it reacts and forms a coating. The required conditions for this cannot be met without creating stably operating automated equipment (plasmatrons, gas-, water-, and electric supply lines, powdered material metering devices, etc.), as well as developing the physical-mathematical foundations of heterogeneous plasma jets and the interaction of atomized particles with the surface. Solution of the above problems would link together the "plasmatron-jet-coating" chain. This in turn would make it possible to lay the scientific foundations for designing coating equipment and control of the most important coating characteristics (adhesion strength, density, porosity, surface development, etc.). Several conclusions are drawn from a literature survey of the above. Figures 9; references 66: 45 Russian, 21 Western.

12765

UDC 541.13

Cavitation Phenomena in Liquids Saturated with Gas

18410486a Moscow ELEKTROKHIMIYA in Russian Vol 23, No 6, Jun 87 (manuscript received 29 Dec 85) pp 832-836

[Article by Yu.G. Chirkov, V.I. Rostokin, and A.G. Pshenichnikov, Institute of Electrochemistry imeni A.N. Frumkin, USSR Academy of Sciences, Moscow; Moscow Engineering Physics Institute]

[Abstract] The formation of cavities filled with vapor or gas-vapor mixtures in dropping liquids is called cavitation. Cavitation bubbles are formed where the pressure in the liquid becomes less than some critical value, thereby facilitating the rapid growth of a vapor bubble which subsequently collapses when the bubble is transferred to a high pressure region by a stream in the liquid. The two known types of cavitation are hydrodynamic and acoustic. In the present work, data are presented on the possible existence of a third electrochemical type in gas saturated liquids. This name was selected because many electrochemical processes, such as electrolysis of water, chlorine production, and electrochemical treatment of metals, are conducted in the presence of aqueous electrolyte solutions saturated with gases, which are released at electrode surfaces due to electrochemical reactions taking place there. If the gas-saturated liquid moves (normally due to the forced circulation of the electrolyte), then the equilibrium gas nuclei, which are always present in a saturated liquid, could become cavitation nuclei. Moving on to a region of higher or lower saturation, the equilibrium nucleus, whose radius is inversely proportional to the saturation, begins to increase or, respectively, decrease in size. The nature of the evolution of a gas bubble in the expansion stage is governed by complex conditions, such as the geometry of the duct (e.g., interstitial electrode profile), hydrodynamic features, current density, or type of electrochemical reaction, and must be specially investigated. It is simpler to study the bubble collapse phase. Data are presented on the evolution of collapsing bubbles in a liquid maintained at a constant saturation. Figures 4; references 8: Russian.

12765

UDC 541.14

Photoelectrochemical Behavior of Silicon, Coated with Protective-Catalytic Film of Ruthenium-Titanium Oxide

18410013a Moscow ELEKTROKHIMIYA in Russian Vol 23, No 8, Aug 87 (manuscript received 28 Aug 86) pp 1113-1117

[Article by A.M. Kraytsberg and Yu.V. Pleskov, Institute of Electrochemistry imeni A.N. Frumkin, USSR Academy of Sciences, Moscow]

[Abstract] For the purpose of photoelectrochemical conversion of solar energy, a photoelectrode must have light photosensitivity with an energy of 1.1-1.5 eV per quantum. While this condition can be met with such semiconductor materials as InP, GaAs, and Si, these substances are not stable under conditions of photoelectrolysis of aqueous solutions, either going into solution or becoming coated with a non-conducting oxide film. Silicon is an especially promising material for making photo-anodes because it has a near optimum forbidden band width (1.1 eV) and because industrial production of silicon is already organized. Therefore, much work has been devoted to protecting a silicon photoelectrode by coating it with a film which prevents oxidation but which does not prevent photoelectrolysis. Coatings consisting of metal silicides, conducting polymers and metals, and semiconductor oxides have been used. Since the protective film must also be catalytically active, this involves making complex composite coatings of several layers which include special catalytic additives. In the present work, a joint ruthenium-titanium oxide was chosen as a protective layer over silicon. This material is known to have metallic conductivity, and anodes prepared from it are stable and highly electrocatalytic in halogen ion oxidation reactions. Electrodes were prepared from standard industrial single crystal n-type silicon disks Grade KEF 4,5.8b of a 300 micrometer thickness with surface orientation [100] and 4.5 Ohm-cm specific resistance. The coatings were applied by four different methods, and the photo-oxidation of halogen ions was studied. The study shows that the Ru-Ti oxide film does protect the silicon from photocorrosion. A well-expressed "strengthening" of the Fermi level at the Si/coating interface was observed. Figures 2; references 11: 3 Russian, 8 Western.

12765

UDC 541.133-165

Solid Electrolytes in System Li_4GeO_4-Li_2WO_4

18410013b Moscow ELEKTROKHIMIYA in Russian Vol 23, No 8, Aug 87 (manuscript received 29 Dec 85) pp 1124-1127

[Article by Ye.I. Burmakin and V.N. Alikin, Institute of Electrochemistry, Urals Science Center, USSR Academy of Sciences, Sverdlovsk]

[Abstract] Solid solutions in systems of the type Li_4GeO_4-Li_xEO_4, where E = a penta-or hexa-valent element and x = 2 or 3, are one of the highest conducting solid lithium-cationic electrolytes currently known. In continuation of a study of similar systems, results are presented on the title system. The solid electrolytes were synthesized by a reaction of Li_4GeO_4 (prepared by a reaction of lithium carbonate with GeO_2) with Li_2WO_4. X-ray phase analysis shows that the solid solutions fail to preserve the lithium orthophosphate structure but have a structure similar to the high temperature modification of lithium orthophosphate. Introduction of lithium tungstate to lithium orthogermanate results in a sharp drop in electrical resistance, reaching minimal values of 0.7-0.8 Ohm-cm at 700 degrees C and 12-15 Ohm-cm at 300 degrees C. Specific resistance and activation energy of conductivity were observed at 10-20 mole % lithium tungstate. Increasing the latter beyond 20 mole % results in a marked increase in electrical resistance due to the presence of poorly conducting phases. The characteristics of solid solutions in the title system at high temperatures are typical for lithium germanate-based electrolytes. However, due to the fact that the change in activation energy of conductivity during phase transition is very small, at low temperatures, these electrolytes are one of the most highly conductive, having a specific resistance on the order of 10^4 Ohm-cm at room temperature. Figures 3; references 9: 7 Russian, 2 Western.

12765

Discoveries of Scientists at Electrochemistry, Aviation Institutes

18410095 Moscow VECHERNYAYA MOSKVA in Russian 5 Nov 87 p 2

[Excerpt] A large group of scientists has been awarded certificates for discoveries at a ceremony held at the USSR State Committee on Inventions and Discoveries. There were a considerable number of Moscow scientists in this group.

In particular, Professor B. Kabanov, Doctor of Chemical Sciences D. Leykus, and other associates of the USSR Academy of Sciences' Institute of Electrochemistry imeni Frumkin theoretically substantiated and demonstrated that alkali metals are capable of combining with hard metals in aqueous solutions. This basic work has opened up broad prospects in the development of fundamentally new methods for obtaining alloys with diverse properties.

Doctors of Technical Sciences E. Kalinin and G. Dreytser and Candidate of Technical Sciences S. Yarkho, scientists at the Aviation Institute, received a certificate for work in the fields of fluid and gas mechanics.

FTD/SNAP

/06091

Unit for Photochemical Conversion of Solar Energy with Storage

18410104b Moscow ELEKTROKHIMIYA in Russian Vol 23, No 10, Oct 87 pp 1443-1445

[Article by A.V. Gorodyskiy, V.N. Zhuravleva, I.I. Karpov, G.Ya. Kolbasov, Yu.V. Pleskov, and Yu.I. Kharkats, Institute of Electrochemistry imeni A.N. Frumkin, USSR Academy of Sciences, Moscow, and Institute of General and Inorganic Chemistry, UkSSR Academy of Sciences, Kiev]

[Abstract] One of the problems complicating the development of units for converting solar energy is the inability to accumulate the energy produced. A system is described in which an electrolyzer is coupled with a regenerative-type photochemical solar battery, thereby enabling conversion of an intermediate product, i.e., electric energy, into chemical energy (in the form of liberated hydrogen gas). The battery consists of 16 elements (each with an area of 15 cm^2 arranged in 8 parallel-connected pairs that are then series connected directly into the electrolyzer. The mock-up electrolyzer used a solid polymer electrolyte (with an electrode area of 10 cm^2) that was based on an MF-4SK cation exchange membrane and electrode-catalysts made of noble metals. The volt-amperic characteristics of the solar battery turned out to be somewhat inferior to the design values. At the maximum output point, the working voltage ranged from 1.45 to 1.50 V, and the current ranged from 50 to 55 A. The efficiency with which the electric energy produced by the solar battery is converted into chemical energy was determined to be 85%. The total efficiency of the "solar-to-hydrogen" unit was 1.28% and was limited primarily by the value of the solar battery's efficiency factor. Figures 2; references 9: 5 Russian, 4 Western.

7813

Investigation of Electrochemical Characteristics of Lithium-Lithium Nitride System

18410104a Moscow ELEKTROKHIMIYA in Russian Vol 23, No 10, Oct 87 pp 1387-1391

[Article by S.B. Porodnov, N.N. Batalov, V.P. Obrosov, G.G. Arkhipov, and Z.S. Martemyanova, Institute of Electrochemistry, Ural Scientific Center, USSR Academy of Sciences, Sverdlovsk]

[Abstract] There has only been one study devoted to the conductivity of Li_3N at temperatures above 473 K. Therefore, the conductivity of the system Li-Li_3N was studied in the 473 to 723 K temperature range by using lithium (reversible) and nickel (blocking) electrodes. In addition, polarization changes at the liquid Li-Li_3N interface were studied in a specially constructed trielectrode quartz cuvette. Analysis of the curves showed that impeded charge transfer resulted in an overvoltage. The overvoltage was of a nondiffiusive nature, and the electrode processes were highly reversible. The exchange currents of the anode process ranged from 2.0 to 16.4 A/cm^2 in the 573 to 723 K temperature range and manifest an Arrhenius dependence with an activation energy of 50.4 kJ/mol. The cathode branches of the polarization curves have a different slope and bend at low overvoltages and were estimated to be between 5.87 and 20.8 A/cm^2 at temperatures ranging from 573 to 723 K. The activity of the lithium was determined from measurements of the electromotive force of the cell. Unfortunately, the measurement results had a very low reproducibility: at a temperature of 773 K, the cell's electromotive force ranged from 0 to 2.5 mV for a lithium nitride content of 5 mol. %. It could, however, be concluded that the activity of metallic lithium in a solution saturated with nitride up to 5 mol. % is close to unity. Figures 5; references 13: 2 Russian, 11 Western.

7813

Selecting Microorganisms which Destroy Heterocyclic Xenobiotics

18410141 Kiev KHIMIYA I TEKHNOLOGIYA VODY in Russian (manuscript received 30 May 86) Vol 9,No 5,Sep-Oct 87 pp 442-445

[Article by G.N. Dmitrenko, P.I. Gvozdyak, and V.M. Udod, Institute of Colloid Chemistry and Water Chemistry imeni A.V. Dumanskiy, UkSSR Academy of Sciences, Kiev]

[Abstract] Adaptation of microorganisms to some widely used saturated nitrogen- and/or oxygen-containing heterocyclic xenobiotics was described and discussed. Morpholine, piperazine, dioxane, tetrahydrofuran and N-methylpyrrolidone were studied. Study of the capacity of Bacillus, Pseudomonas, Micrococcus and Athrobacter genera to utilize these substances in concentrations of 0.05-0.5 g/l did not reveal destructors among these strains. Adaptation of the microorganisms to the synthetic substances was carried out best in a flow, due the microorganisms' ability to attach to solid surfaces. Xenobiotic concentration in the culture fluid must be kept low to circumvent its toxic effect on the adapting culture. This facilitates development of resistance of the microorganisms to the synthetic substance and permits use of the xenobiotic as a sourre of nutrition. Selection of active strains, taking destructive and adhesive properties into consideration, must be carried out during periodic cultivation in the presence of an inert packing with a developed surface. Such selection produced the most commercially suitable cultures which are active in destructive and autoimmobilization properties. References 13; 9 Russian, 4 Western.

02791

Feasibility of Storing Liquid Complex Fertilizers in Reinforced Concrete Tanks

18410490 Kiev KHIMICHESKAYA TEKHNOLOGIYA in Russian No 4, Jul-Aug 87 (manuscript received 15 Jul 86) pp 23-26

[Article by A.N. Volovikov, T.M. Mozgushina, B.A. Idashkina, V.G. Musin, and Yu.A. Vakhrushev, Cherkasskiy Production Association]

[Abstract] The problem of storing liquid complex fertilizers has become very real because the carbon steel tanks currently being used are not corrosion resistant. Furthermore, the shortage of tanks holds back liquid fertilizer production, especially during the cold time of year. Concrete appears to be promising as a construction material for this purpose, and data were obtained on the action of 10:34:0 ammonium ortho- and polyphosphate liquid fertilizers on concrete. Test solutions contained 10% nitrogen and 34% phosphorus (as phosphorus pentoxide); they had a pH of 7, a density of 1.400-1.405 g/cm^3, and a viscosity 0.034 Pa·s. Test samples measuring 4X4X4 cm were prepared from a 1:3 portland cement-sand mixture, according to GOST 310-60, and stored for 28 days at normal humidity. Corrosion resistance was observed after total immersion in the liquid fertilizers and with partial immersion. Water was used as a control. After six months of testing, the mass of the totally immersed samples decreased by 6.31%, and that of the partially immersed samples by 3.78%. Geometric dimensions also decreased insignificantly — to 0.8 mm, while the shape of the samples that were totally submerged for 6 months did not change. An increment in strength was observed after two months which was attributed to a continuation of the cement hardening process under water. After 6 months, however, a decrease in strength was observed which was evidently due to penetration of ortho-phosphates and the formation of calcium phosphate, which fractured the structure. Therefore, the service life of concrete tanks will depend on the density of the concrete and the quality of the initial cement mixture. Service life may be increased by coating the tanks with bituminous materials. Tests were also run on experimental tanks, measuring 1160 mm in diameter and 1000 mm in height. After 12 months of storing liquid fertilizers, only a slight flaking was observed. Therefore, pilot scale testing confirmed the laboratory results that liquid complex fertilizers are insignificantly corrosive to concrete. Tables 3.

12765

Application of Urea-Formaldehyde Coating onto Ammonia Nitrate Granules

18410142 Ivanovo IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: KHIMIYA I KHIMICHESKAYA TEKHNOLOGIYA in Russian Vol 30, No 8, Aug 87 (manuscript received 18 Mar 86) pp 94-97

[Article by L.N. Ovchinnikov, A.G. Berdnikov, V.A. Kruglov, K.B. Stepanov, and V.N. Kiselnikov, Department of Chemical Engineering Processes and Equipment, Ivanovo Chemical Engineering Institute]

[Abstract] One of the most effective means of improving the mechanical and agrochemical properties of mineral fertilizers and decreasing the cost of their storage, transportation, and application to the soil is application of polymer films to the surfaces of the granules. A distinction is made between conditioning and encapsulating processes. The authors studied the feasibility of conditioning ammonium nitrate granules in a falling stream of particles, as well as a series of devices which utilize a falling stream and a fluidized bed, under laboratory conditions. Product samples were taken after 10 and 20 minutes in the fluidized bed to determine caking properties, strength, and solubility of the granules. The granules in the falling stream were sprayed with a solution of urea in Formurea-80, a urea-formaldehyde. Graphs illustrate the influence of the quantity of the conditioning substance applied to the granule and holding time in the fluidized bed on caking properties. Spraying in the falling stream is found to be effective only when an initiator is used. Conditioning does not greatly increase strength or dissolution time. These characteristics can be greatly improved and caking completely prevented by encapsulating the granules in a urea-formaldehyde compound in fluidized-bed equipment, creating a protective film with a mass of 1% or more of the mass of the fertilizer. Required treatment times decrease with increasing temperature, to 34 minutes at 50 degrees C without initiator and 7.5 minutes with initiator, and then to 17 and four minutes at 70 degrees C, respectively. Caking is minimized by using the urea-formaldehyde compound in the amount of 2%, which increases strength by a factor of 1.6 and dissolution time by a factor of 6-7. Figures 4; references 5: Russian.

06508

UDC 546.882'261:537.312.62

Heat Capacity, Superconductivity, and Order-Disorder Transition in Non-Stoichiometric Niobium Carbide

18410472 Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 61, No 7, Jul 87 (manuscript received 22 Jan 86) pp 1761-1766

[Article by A.A. Rempel, A.I. Gusev, Ye.M. Gololobov, N.A. Pryshkova, and Zh.M. Tomilo, Institute of Chemistry, Urals Science Center, USSR Academy of Sciences, Sverdlovsk]

[Abstract] Niobium carbide belongs to a class of non-stoichiometric compounds of transition metals with non-metals and is a superconductor having a type B1 structure. This compound is characterized by partial filling of the positions taken by introduced atoms, i.e., the presence of structural vacancies, and therefore has the capability of forming various types of ordered phases. In early research on the superconducting properties of niobium carbide, it was observed that the transition temperature into the superconducting state rapidly decreases with increasing concentration of structural vacancies. However, it should be taken into account that this work was done without an analysis of the distribution of introduced atoms in the non-metallic sub-lattice. Evidence also shows that, depending on the heat treatment conditions, the carbon atoms in non-stoichiometric niobium carbide may be distributed in either an ordered or disordered state. Any change in the structure of niobium carbide during ordering of carbon atoms must inevitably result in restructuring of its electron and phonon spectra. It thus becomes imperative to determine the effect of atom ordering in niobium carbide on the transition temperature to the superconducting state. In the present work, niobium carbide samples of various compositions were synthesized in the ordered and disordered states, and their heat capacities and transition temperatures to the superconducting state were measured. On the basis of experimental data, the band density of the compounds at the Fermi level and the electron-phonon interaction constant were determined. A qualitative quasi-two-dimensional model of superconductivity is proposed as an explanation of the superconducting properties of niobium carbide. Figures 2; table 1; references 9: 4 Russian, 5 Western.

12765

UDC 669.018.45.57

Fabrication of Ceramic Products by Hot Casting under Pressure

18410484 Ivanovo IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: KHIMIYA I KHIMICHESKAYA TEKHNOLOGIYA in Russian Vol 30, No 5, May 87 (manuscript received 25 Nov 85) pp 122-123

[Article by G.A. Gerasimova, L.V. Kudryasheva, and S.S. Ordanyan, Leningrad Engineering Institute imeni Lensovet, Chair of Chemistry and Engineering of Fine Industrial Ceramics]

[Abstract] Shaping of ceramic products may be accomplished by various methods, such as pressing at room temperature (followed by baking and hot pressing), extrusion, hot casting under pressure, or slip casting. In the present work, hot casting under pressure was selected as a method for shaping ceramic products, consisting of "non-plastic" rings made of high-melting-point carbides and Group IV-V transition metal borides, and it was demonstrated that quality becomes a function of correctly selecting a number of casting parameters, such as temperature, air pressure, binder concentration, and cooling time. Optimum casting parameters were determined for fabricating large ceramic products from "non-plastic" materials, and the relationship of initial slip temperature to shaping time and temperature of surface formation was determined. Figures 2; references 4: Russian.

12765

Effect of Laser Treatment on Structure, Composition, and Microhardness of Plasma Coatings of Fe-C-Cr-V Systems

18410486c Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA TEKHNICHESKIYE NAUKI in Russian No 3, May-Jun 87 (manuscript received 17 Jan 86) pp 106-109

[Article by V.P. Larionov, N.P. Bolotina and T.V. Argunova, Institute of Engineering Physics Problems of the North, Yakutsk]

[Abstract] The adhesive strength of plasma-applied coatings used to increase the wear-resistance of surfaces is not always as strong as desired, and research continues on further treatment of the plasma coating. In the present work, a study was made of the effect of laser treatment on the adhesion strength of 0.3-0.4 mm thick plasma coatings consisting of the Fe-C-Cr-V system on a low-alloy steel. The coatings were then subjected to continuous carbon dioxide laser treatment at 4 levels of applied power: 1.9, 1.5, 1.2, and 1.0 kW. Metallographic analysis of the coatings before and after laser treatment showed a marked difference in structure. The untreated coatings displayed a complex striated structure having dark, gray, and light phases and various sized regions of impurities. Fissures and striations were observed at the coating-base interface. After laser treatment, the coating structure changed markedly: the coating and portions of the base metal were re-melted, and a new composition was formed in the surface layer. Maximum re-melting (to 1.7 mm) occurred at 1.9 kW. Laser treatment was thus found to have a positive effect. All samples studied showed a lack of pores, fissures, and striations, and a firm chemical bond was found to exist between the coating and the matrix. Research also showed that the nature and strength of the coatings may be controlled by the applied power of laser treatment. Changes in microhardness are due to alterations in degree of alloying in

the formed solid solutions, in phase and chemical compositions, and in the formation of fine crystalline structures having dispersed reinforcing phases. Figures 3; references 5: Russian.

12765

Work on Thick Diamond Films at Physical Chemistry Institute

18410096 Moscow NTR: PROBLEMY I RESHENIYA in Russian 8-21 Sep 87 p 6

[Article by V. Pokrovskiy]

[Abstract] The article reports on development of methods for obtaining thick films made of artificial diamond at the USSR Academy of Sciences' Institute of Physical Chemistry. These films are said to be suitable for coating dielectric heatsinks, as well as products used in instrument building, optics, surgery, and other fields. Personnel of the institute are quoted in regard to a recent NEW YORK TIMES article which compared U.S. and Soviet achievements in this field.

Doctor of Chemical Sciences D.V. Fedoseyev related that this article used information obtained from a University of Pennsylvania scientist who once observed a diamond-like film being grown in Fedoseyev's laboratory. This film was 1 micron thick. As reported last year in the journal DOKLADY AN SSSR (Papers of the USSR Academy of Sciences), films of true synthetic diamond that are more than 100 microns thick have also been grown at the institute as a result of work done under the general direction of B.V. Deryagin, corresponding member of the Academy. A group headed by Candidate of Technical Sciences B.V. Spitsyn, a former associate of Fedoseyev's laboratory, is credited with this achievement. Up to now, however, it has received less publicity in the Soviet Union than other developments of the laboratory, according to Spitsyn.

The USSR Academy of Sciences, the USSR State Committee for Science and Technology, and the heads of the Physical Chemistry Institute itself are said to be paying more attention to work on thick diamond films. An independent laboratory has been set up on the basis of Spitsyn's group, for example, and creation of still larger organizations for diamond-film R&D is said to be under consideration.

FTD/SNAP

/06091

Prize for Work on Isovalent Doping of Semiconductors

18410131a Moscow VECHERNYAYA MOSKVA in Russian 8 Dec 87 p 2

[Excerpt] Professor V.I. Fistul, head of a chair of instruction at the Institute of Fine Chemical Engineering imeni Lomonosov, is a prominent specialist in the field of semiconductor physics.

Viktor Ilyich has trained 35 candidates and four doctors of sciences. He is the author of a scientific discovery and 30 inventions, many of which have been introduced in industry.

Viktor Ilyich and a group of scientists have received the 1987 USSR State Prize for the work-cycle "Physicochemical Principles of Isovalent Doping of Semiconductors." This honorary title has been conferred upon Professor Fistul twice. The first time was in 1975.

[A photograph is given showing Fistul and V. Balabanov, an associate of the chair of instruction, working with laboratory equipment.]

FTD/SNAP

/06091

All-Union Seminar on Semiconductor-Device Physics, Chemistry

18410131c Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 17 Nov 87 p 1

[Article by V. Stupak, correspondent (Pavlodar)]

[Excerpt] The city of Pavlodar recently became, for the first time in its history, the place where an All-Union seminar of the USSR Academy of Sciences was held. This seminar was devoted to basic research in the field of physics and chemistry of semiconductor devices. Scientists from Moscow, Leningrad, Kiev, Tashkent, Kazan, and 10 other research centers of the country gathered at the seminar.

Associates of the Pavlodar Industrial Institute are working on the study and use of narrow-band semiconductors which hold promise for development of instruments with unique properties, including heat and light detectors capable of measuring temperatures with absolute precision from great distances. This opens up new possibilities for heat and power engineering and for probing the atmosphere with laser instruments in order to study, for example, pollution of the atmosphere by waste products of thermal power stations in Ekibastuz. Five years of experience, which the institute's nuclear physics laboratory has amassed, permit such conclusions to be drawn. Introduction of some of this laboratory's developments into the economy has already begun.

FTD/SNAP

/06091

All-Union Conference on Luminescence of Crystals, Molecules

18410131b Tallinn SOVETSKAYA ESTONIYA in Russian 28 Oct 87 p 1

[Article by A. Favorskaya (interviewer)]

[Excerpt] An All-Union Conference on Luminescence opened in Tallinn on 27 October. Emphasizing the importance of research in this field, Ch. Lushchik, corresponding member of the Estonian Academy of Sciences and chairman of the conference's program committee, told our correspondent in an interview:

"'Luminescence of Crystals and Molecules' is the topic of the present conference. Work in which Estonian physicists under the direction of K. Rebane, president of the Estonian Academy, played a large role—questions of selective spectroscopy are being discussed, as well as other important and interesting problems. A paper by P. Saari, director of the Estonian Academy's Institute of Physics, is devoted to superfast processes, for example. The second day is given over to discussion of interesting problems connected with luminescence of ionic crystals and high-temperature superconductors. Physicists from Tartu also are taking part in this work.

"It must be said that the conference is a very representative one; 12 republics and 50 cities are represented. I might note also the very high level of the 300 participants; more than half of them are doctors of sciences and members of republic and all-Union academies."

"Does the conference open up new horizons for practical work?"

"Beyond the largely theoretical topics of the conference lie applied problems, of course, and they are of the largest caliber, including high-temperature superconductivity.

"Papers presented at the conference were screened very rigorously, by the way; we accepted one out of every four that were submitted, which was unprecedented in our practice. There will be 200 papers, 40 of which will be read and 160 displayed on stands."

FTD/SNAP

/06091

Oxidation of Metals and Semiconductors in Nonequilibrium Plasma

18410143 Ivanovo IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: KHIMIYA I KHIMICHESKAYA TEKHNOLOGIYA in Russian Vol 30, No 9, Sep 87 (manuscript received 20 May 86) pp 3-16

[Article by A.I. Maksimov and V.A. Titov, Department of Instruments and Materials for Electronics Engineering, Ivanovo Chemical Engineering Institute]

[Abstract] This literature review covers oxidation of metals and semiconductors in a low-temperature nonequilibrium plasma. Methods for implementing plasmochemical oxidation are discussed, including dc, high-, and very-high-frequency discharges excited by means of internal electrodes or an external resonant system in dielectric or metal reactors, using oxygen or an oxygen-containing mixture as the plasma-forming gas. Specimens may be placed in a gas flow activated by the plasma but not in direct contact with the plasma, or the specimens may contact the plasma, with or without itself being connected to a positive or negative electrode. Metals and semiconductors investigated in the literature covered by the review are listed in a table. Studies of oxide film growth kinetics indicate that the initial phase of oxidation is complicated by a number of poorly reproducible factors, including changes in physical and chemical properties of the film and of the surface treated as the film initially grows. The oxidation rate increases with increasing temperature and varies with pressure, reaching the maximum at an intermediate pressure. The oxidation rate generally increases with increasing discharge power, although one author reported reaching a maximum on this curve as well. The composition of the oxide films is generally stoichiometric, their structure being isomorphic. The mechanism of plasma oxidation of metals and semiconductors has centered around the problems of transfer of reagents in the condensed phase and the nature of active particles and their generation in the gas phase or heterogeneous processes. A description of the growth kinetics requires consideration of a number of factors not yet investigated. The mechanism of transportation of the oxidant through the oxide layer has not yet been clarified. The nature of the active particles responsible for plasma oxidation and the mechanism of their transport will require further studies. Figures 9, references 122: 48 Russian, 74 Western.

06508

Research at General and Inorganic Chemistry Institute imeni N.S. Kurnakov

18410086 Moscow KHIMIYA I ZHIZN in Russian No 10, Oct 87 pp 34-37, 82-83

[Article by special correspondent V. Stantso: "The Immense IONKh"]

[Text] One hundred thirty paces along its facade....

It is the largest building opposite Neskuchnyy Garden. It is solid, vast and spacious: it was capable of accommodating most of the laboratories of one of the first Academy institutes created by the Soviet government — the Order of Lenin Institute of General and Inorganic Chemistry imeni N. S. Kurnakov — IONKh for short.

Today's IONKh has a little fewer than 30 laboratories, dealing with the most important problems of inorganic and general chemistry — fundamental, applied, and chemical engineering, interpreted in the teaching "logos" of the institute as the science of production.

And in general, the meaning and essence of IONKh can probably be reduced to two key words of all chemistry — analysis and synthesis....

Predecessors

The history of IONKh is officially reckoned from 11 May 1918, the day of the first meeting of the Scientific Council of the just-created Institute of Physicochemical Analysis.

The Scientific Council of another institute — the predecessor of IONKh — convened for the first time 3 days earlier. This institute, which was also an Academy institute, was created to study some of Russia's indigenous resources —platinum and other precious metals. And the oldest root of IONKh extends back into the 18th century — to Russia's first scientific chemical laboratory, founded by Lomonosov and later named the Laboratory of General Chemistry of the Academy of Sciences. It existed for almost 200 years, and the year of its founding was 1748.

In 1934, a Soviet government decree merged the Laboratory of General Chemistry, the Institute of Physicochemical Analysis, and the Institute for Platinum Research into the single Institute of General and Inorganic Chemistry. In that same year, IONKh was moved to Moscow together with the Academy. Academician Nikolay Semenovich Kurnakov, whose name the institute bears, became its first director. Kurnakov died in 1941. Academician Ilya Ilich Chernyayev — a chemist of the Chugayev school and a prominent specialist on platinum metals and the chemistry of coordination compounds, became his successor. Since 1962, for a quarter of a century already, IONKh has been under the direction of Academician Nikolay Mikhaylovich Zhavoronkov. Here is what he has to say.

"Today's IONKh is continuing the traditions of its founders, developing general chemistry, physicochemical analysis, and the chemistry of coordination compounds. Inorganic synthesis and the theoretical principles of new chemical technology are also some of our strategic directions.

"Many of our laboratories and groups are intended, speaking in Lomonosov's words, 'chiefly to uncover physical truths through chemistry.' And in precisely the same way, physical research methods are being widely used in all the institute's subdivisions to uncover chemical truths.

"We are also continuing our development of the chemistry of complex (coordination) compounds, which originated in our country with the classical works of Chugayev and Chernyayev. These days, a new branch of coordination chemistry has been forming, biocoordination chemistry, and IONKh is conducting research in this promising direction. We are involved, after all, not only with inorganic chemistry but also general chemistry."

Another veteran of IONKh, Academician Ivan Vladimirovich Tananayev — the first recipient of the N.S. Kurnakov prize, a highly prominent specialist on the chemistry of fluorine and rare elements and one of the founders of the teaching on inorganic polymers, continues the discussion on the unbreakable tie between the present and the past.

"I believed it to be my mission and my responsibility to preserve and develop Kurnakov's teaching. Many useful materials, alloys primarily, were created earlier on the basis of Kurnakov's 'composition-property' state diagrams.

"Now the diagrams have grown more complex, to include composition, property, particle size distribution, and structure. Everything is associated with these diagrams — synthesis of all new compounds or classes of compounds or materials needed by modern technology.

"We need to focus our attention today on ultrafine materials: both their structure and their properties differ from those of larger conglomerations. The melting point is said to be a constant, but it is found to be hundreds of degrees lower for many materials when they are very highly pulverized.

"Physicochemical analysis is at a new level of knowledge. Without exaggeration, it is an all-embracing teaching, and it will continue to be an object of serious study for many generations of chemists to come."

Salt and the Gist of It

While I have had several encounters with academicians Zhavoronkov and Tananayev, prior to this year, I had known RSFSR Honored Scientist and Technician I.N. Lepeshkov only from his published scientific works and from editorial work on the article "Gulf of Passions" published in KHIMIYA I ZHIZN in June. He was the sole expert chemist who consistently opposed closing the strait, doing everything he could to save the Gulf of Karabogaz.

Our interview began with the problem of Karabogaz, and I take sincere pleasure in reporting to readers that Professor Lepeshkov does not believe the matter to be hopeless, that man could still preserve this unique gulf by working with nature — with it and not against it. It is something that man can and must do.

Together with students and associates, Ivan Nikonovich is currently conducting research, in particular on the mineral resources of the Caspian region in connection with recent initiation of its integrated development.

Karabogaz is part of this region, and the northern part of Astrakhan Oblast, as well as some salt lakes of western Kazakhstan, are the former bottom of the ancient Permian Sea. The Permian Sea gave birth to the famous potassium deposits of Solikamsk, to the polyhalite deposits of the southern reaches of the Ural, and to the numerous salt lakes of this region. In the course of his long life, Ivan Nikonovich roamed and rode every inch of the shore and bottom of this sea. Together with his associates and students, he gathered a rare collection of natural salts and traced the history of these salts in time and in space, though from the standpoint of a chemist rather than a geologist. But the country's geological map bears mineral deposits discovered with the direct participation of chemist I.N. Lepeshkov.

Here is just one example.

The healing properties of bischofite are now legendary. Bischofite is the magnesium mineral $MgCl_2 \cdot 6H_2O$. Natural solutions of this mineral are currently being procured in Volgograd Oblast. This deposit, one of the last deposits of the Permian Sea, was discovered by two oil geologists together with chemist Lepeshkov.

The bulk of the bischofite solutions procured today is used to combat road ice, and as a drilling mud additive. Doctors have also become interested in bischofite as an agent against radiculitis and other joint diseases. Everything seems to be proceeding normally: the deposit is being developed and extraction is growing, but Lepeshkov is still unsettled. The Volgograd bischofite deposit is being developed too slowly, and not completely enough: different agencies select out the elements as "ours" and "theirs." They isolate one, two, or a maximum of three elements. But a minimum of 64 elements have been counted in Permian Sea deposits. The same goes for Lake Inderskoye, where the salt beds are 10-15 m deep. Table salt is of very high quality here. But this salt also contains potassium, bromine, and boron, which are still not being utilized: only pure halite is being mined.

The best minds of the IONKh have long been fighting for integrated use of mineral resources. Lepeshkov in particular. This is why in his 80th year of life, he eagerly responded to a proposal by Academician A.G. Aganbegyan to take part in the work of an expeditionary team of the KYePS (the Commission to Study Russia's Natural Productive Forces, founded back in 1915 on V.I. Vernadskiy's initiative) for integrated exploration of the Caspian economic region. Scientists of the IONKh are now studying potassium-magnesium-boron salts brought from there. It is important that not only chlorides but also sulfates are among these salts. They can be used to produce chlorine-free multi-ingredient fertilizers needed by the cotton fields of Central Asia.

"The time for integrated development of Caspian salt deposits has now come," Lepeshkov argues, "all the more so because the energy resources are available (see "The Astrakhan Treasure House" in KHIMIYA I ZHIZN, No 7, 1986), as are water resources, limited though they may be."

Such is the gist and the meaning of future operations.

A Platinum Root and a Golden Bottom

This seems a good place for me to trace the development of all three main directions, of the three roots of IONKh — Lomonosov's, Kurnakov's and Chugayev's. IONKh still has the Laboratory of Complex Compounds of Platinum Metals and the Laboratory of Analytical Chemistry and Refining of Precious Metals. But it so happened that one of the most interesting projects, associated with noble gold, was not conducted at them but at the Laboratory of the Structure of Inorganic Compounds. Because our journal described this work in rather great detail a few years ago (in No 10, 1984), I will briefly recall only the main points.

It is important not so much for prospectors as for miners of the "King of Metals" to know what kind of gold they are dealing with — nuggets or ore. As Doctor of Chemical Sciences V.I. Nefedov validly wrote long ago in his article "An Immeasurably Thin Layer," to select flotation reagents, it is extremely important to know the surface composition of gold grains.

His laboratory was involved (and continues to be involved) with developing electron spectroscopy. This, by the way, was the first IONKh laboratory in which we would not see the ubiquitous fume hoods, reagent bottles, and other traditional chemical paraphernalia. It is a purely instrumental laboratory equipped with the most up-to-date instruments, in which research is automated and computerized to a high degree.

It may be said that identification of gold was one of the unexpected practical applications of purely fundamental research, having the objective of improving the method. As a result, a possibility arose for observing what transpires in an extremely thin surface layer up to 20 Angstroms thick. It is precisely here in natural gold that invisible transformations and reactions occur.

X-ray and electron studies showed that silver impurities are oxidized chiefly in the outer layer of gold ore, which is responsible for the arrest and accumulation of silver on the gold surface. The thickness of this oxidized layer is hundredths of a micron. On the other hand, silver in particles of placer gold is gradually leached from the surface. This is why there is less silver on the outer layer of such particles than inside them.

I will not go into the physical essence of the method — into the way in which electrons are knocked out of the ultrathin surface layer and how the chemical information these electrons carry is interpreted. What is important is that IONKh is currently a world leader in developing and understanding this important instrumental method. This is why Soviet chemists, and not American

chemists, were the first to observe particles of unoxidized iron in lunar regolith. Reports of this discovery were published worldwide at that time. A certain Swiss newspaper titled a report on this topic quite aptly: "The Moon Doesn't Rust!"

IONKh chemists explained the reasons why lunar iron exhibits such unusual chemical stability. One of them has to do with the action of solar wind. This was demonstrated experimentally by bombarding steel disks with ion beams; in this case, only half of each disk was exposed to the ions. Then these specimens were placed in a more corrosive medium — in an acid for example. The half of the disk that was not bombarded by ions became covered with a reddish rust deposit in just minutes, while the other remained shiny and clean.

It is a pity that for the time being, ionic anticorrosion treatment of metal is too expensive. But in principle, this is a very interesting and possibly a promising method of raising the corrosion resistance of materials; moreover, as frequently happens, the method was borrowed from nature, though of course this time from extraterrestrial nature.

Anyway, let us return to gold. It deserves attention at least because it is a very valuable material, but also because it is sometimes a technically necessary one. Due to its extremely high chemical stability, it is irreplaceable as a material for making contacts in different types of delicate technical devices, including such ordinary ones as resonators and frequency oscillators. We are told that millions of these quartz plates that vibrate at constant frequency will be needed for color television sets of the next generation. They are currently operating in computers and electronic clocks.

Quartz resonators contain silver electrodes that are gold-plated from above with the purpose of achieving ideal conductivity and the highest possible chemical stability, which guarantees a long service life. Much gold is consumed to protect copper in electronic printed microcircuits.

Research on ultrathin layers conducted at IONKh, using electron spectroscopy, provides the hope that gold may be replaced (in the future) as a protective material in these devices. A special polymer coating will replace it, and, apparently, soon.

And now about the Chugayev root.

A Record Cluster

Clusters have assumed a special direction in the chemistry of coordination compounds in the last 2 or 3 decades. Chemically bound atoms of transition metals make up the core of a cluster, which is itself surrounded by certain ligands, usually organic.

Clusters of the overwhelming majority of chemical elements have already been produced. Their applied significance is not very high for the moment, but their value to research is great, and they have clearly widened the synthetic possibilities of inorganic chemistry.

Defined loosely, clusters may be interpreted as unique inorganic polymers with a low "degree of polymerization." It was asserted in an "Analysis of the Possibilities of Chemical Science" (a survey a thousand pages long) published in 1985 by the U.S. National Academy of Sciences: "The World Record Is Held Today by a Platinum Compound for Which X=38 — a Cluster with the Chemical Formula $Pd_{38}(CO)_{44}^{2-}$."

But even when it was published, in 1985, this assertion was incorrect. That record (if it is even proper to talk about records in science at all) was surpassed several times over by IONKh not long after that. In Fall 1984, Doctors of Chemical Sciences I.M. Moiseyev and M.N. Vargaftik and their associates submitted an article to the editor of DOKLADY AKADEMII NAUK SSSR (Vol 284, No 3, p 896), describing the structure of a new palladium cluster — a catalyst for oxidative acetoxylation of olefins. The metallic core, or "cluster," was of record size: the bound metal atoms were arranged around a central atom in the form of a five-layered icosahedron, and there were a total of 561 atoms in this cluster.

Associates of three of the largest Academy institutes — IONKh, the Institute of Elemental Organic Compounds imeni A.N. Nesmeyanov, and the Siberian Department's Catalysis Institute — studied the record cluster by different methods. But the "supercluster" was synthesized at IONKh.

What Synthesis Leads To

No matter how great the synthetic possibilities of the chemistry of coordination compounds might be, they do not exhaust the pathways of modern inorganic synthesis. IONKh is studying practically all chemical elements, while its seven laboratories are dealing with rare elements. It was at this institute that thousands of compounds of these elements were obtained for the first time. New compounds are being synthesized today as well. It stands to reason that far from every innovation is destined to be practically significant, but sometimes things work out.

A report announcing the discovery of high-temperature superconductivity and of ceramic materials that have this unique property spread through the scientific world like wildfire at the beginning of this year. KHIMIYA I ZHIZN gave this report proper attention as well (see articles in No 5, 6, and 9 of this year). But here is what is significant: lanthanum-strontium and lanthanum-barium ceramics were obtained for the first time back in

1979 by three associates of IONKh in Doctor of Chemical Sciences V.B. Lazarev's laboratory. Moreover, the metallic conductivity of the oxides of certain materials was also discovered at IONKh (N.M. Zhavoronkov and V.B. Lazarev, 1978).

When Lazarev's associates first produced these ceramic materials out of rare-earth and alkaline-earth elements, they studied the dependence of their electrical resistance on temperature. They used the temperature of liquid nitrogen as the lower bound of their range. Ten years later, it was discovered that these materials do not acquire superconductivity until a temperature of 40 K. As was validly noted by A.I. Golovashkin, director of the Superconductivity Laboratory of the Physics Institute imeni P.N. Lebedev: "Had they chilled their samples by another 40 degrees, the effect could have been discovered 10 years ago! One might say they had the firebird by the tail, but...."

This was not the first time things turned out like this, by the way, where IONKh was the first to obtain and study a substance, but people from other institutes — sometimes ours, sometimes foreign — led the substance out onto the highway of technology.

I have gained the impression that the number of purely synthetic projects of IONKh has recently been decreasing. I think the reason for this lies not in exhaustion of the possibilities of inorganic synthesis, but rather in the greater amount of instrumentation available to Academy science. And pragmatism has something to do with it as well. Studying substances with the latest methods and instruments, it is easier to come across innovations than along the pathway of classical synthesis. While these may only be particular findings, they are new ones at that. As a rule, synthesis is more laborious.

I am sitting in the Laboratory of the Chemistry of Rare Elements. Doctor of Chemical Sciences B.F. Dzhurinskiy, the laboratory's deputy director, is describing rare-earth luminophores — some of which were obtained for the first time at IONKh. I am absent-mindedly fingering a clearly nonmetallic golden ingot lying on the table. In my hands, it flakes like a chunk of good natural mica. "What is this," I ask. "It is neodymium plumbite," is the reply, "a by-product of a certain synthetic process." Rare-earth mica is as unusual as it is, for the time being, totally impractical.

Dzhurinskiy's group is now working on mixed salts of rare-earth elements, nontraditional ones at that — salts with mixed anions. What is the usual procedure? Several different cations are attached to one anion. But this pathway has been almost completely exhausted. What we have here is the reverse: the cations are the same, and the anions are different. At the time of my visit, the laboratory was synthesizing a series of rare earth borate-phosphates and germanate-phosphates. It is still too early to write about them, but a few years ago, IONKh did produce lanthanum borate-tungstenate, activated by europium. This turned out to be a promising material for luminophors. This same laboratory also discovered interesting antifriction properties in calcium thiophosphate.

The laboratory has been working on phosphates in general for many years.

It is no longer any secret that some phosphates possess more than satisfactory binding properties. This is why phosphate binders occupy a rather noticeable place today in construction and in the research projects of many sector institutes, among which we should perhaps single out the Central Scientific Research Institute of Construction Designs imeni V.A. Kucherenko.

But here is something that is interesting and unexpected: a dissertation in the pursuit of the academic degree of candidate of art criticism that was defended several years ago concerned itself with phosphates and had a direct relationship to research being conducted by I. V. Tananayev and his students. New paints and a new painting technique were created, due to which the words of Mikhail Bulgakov, "Manuscripts do not burn," now apply literally to works of the fine arts.

To acquaint themselves with these unusual paints and what can be painted with them, scientists from IONKh had to travel to the other end of Moscow, to Novogireyevo, where on the ninth story of a residential building they found the studio of artist O.B. Pavlov, a candidate of art criticism and the inventor of nonflammable phosphate paints.

Phosphate Paints

Candidate of Art Criticism Oleg Borisovich Pavlov teaches painting technique at the Surikovskiy Institute. He comes from a family of artists, and he is a great-grandson of A.K. Savrasov. He is also the inventor of new paints that have come to be called thermophosphate paints. First we will explain why phosphate, and then the prefix "thermo."

All paint, including that used by artists, contains two principal ingredients — pigment and binder. The latter is also a film-forming substance. When oil paints dry on canvas, the hardening linseed oil bonds the pigment particles together to form the "cultured layer." The same function is performed in adhesive paints by aqueous solutions of adhesives, in emulsion paints by dispersed oligomers and polymers, in silicate paints by soluble glass, etc. And the material to which paint is applied (it is unimportant whether it is canvas or cardboard, wet plaster for frescoes, or primed sheet metal) is referred to by artists as the backing.

All of us, and artists especially, are interested in lengthening the life of works of art, and for this to be, both the backing material and the paints themselves must have sufficiently long life. Recall that the oldest works of art that have survived over many centuries were completed as frescoes or mosaics.

There are many amateur painters among the scientific associates of IONKh. A minimum of two of the chemists mentioned in this article "dabbled in art." But phosphate binders owe their existence in the fine arts not to them but to the professional artist Oleg Borisovich Pavlov.

He was interested for many years in the problem of long-lasting materials for painting. A lucky break and chemist acquaintances steered him to the fundamental works of IONKh on phosphate binders.

Pavlov conducted his own experiments, and he found that phosphate binders are fully acceptable for a painter's work. They are soluble in water; pigments of practically all colors (though not of all compositions) disperse themselves in these binders sufficiently uniformly. In the final analysis, Pavlov selected over 20 heat-resistant mineral pigments for his phosphate paints. By trial and error, he arrived at the necessary additives, and in the end, he developed three types of thermophosphate paints — powdered, artistic (in the form of tempera and gouache), and pastel.

Experimental assortments of pastel pencils produced by the Podolsk Production Combine of the USSR Khudfond [not further identified] include over 60 colors and shades. These pencils are used like ordinary pastels, while paints are used almost like ordinary tempera and gouache. Only the final operation of this artwork may appear barbaric at first: the artist takes a gas torch and directs the flame at the painting he has just completed. But the paintings do not burn because they are painted with phosphate paints on a nonflammable backing — sheet aluminum, asbestos board or asbestos fabric, concrete or slate. And using an open flame is not necessary either: other thermal effects may be used. The temperature need not be very high, from 150 to 400 degrees C, and the time of heat treatment is just minutes. But after such heat treatment, a picture painted with thermophosphate paints will succumb to neither flame, nor water, nor mildew, nor the whims of a vandal.

Oleg Borisovich showed me a dozen works painted with thermophosphate paints. They included landscapes, still lifes, portraits, and works of ornamental applied art. To demonstrate to his colleagues the coloring potentials of the new paints, the artist used them to make copies of Dionysian frescoes, and he used thermophosphate pastels to copy Edgar Degas' famous "Blue Dancer."

One of the first exhibitions of pictures painted with these paints by O.B. Pavlov was organized by IONKh as a contributor to his work.

Is It Easy for Young People at IONKh?

It is a natural transition from the topic of art that is young forever to one that is important to every Academy institute, among which IONKh is not an exception — that of the daily routine of those who are commonly referred to as young scientists.

Approximately a third of IONKh's associates are people up to 33 years old. However, I know of several other rather young inorganic chemists who began at IONKh but left it after working three, five, or a few more years.

Being young and vain, in my opinion, they were unable to withstand the competition with the best, and their aspiration to make their mark sooner steered them away from the Academy institute into sector institutes.

I discussed this issue at IONKh without naming names. The institute's old-timers assured me that the drain of the unsuccessful from IONKh has decreased in recent years. Nonetheless, it is difficult for young scientific associates to work in the most famous and prestigious Academy institutes.

How valid this conclusion is, what is being done in the institute to develop and retain young personnel, and what forms and methods of work with young specialists are being used were questions I posed to Andrey Mikhaylovich Bolshakov, chairman of IONKh's Young Scientists' Council.

"Every year IONKh accepts up to a dozen of yesterday's graduates of Moscow State University, the Moscow Institute of Fine Chemical Technology imeni M.V. Lomonosov, and the core department of the Mendeleyev Institute. The first time they come to us, they are still students in their fourth or fifth years, and they are immediately included in the research — in the laboratories in which they will work later. The institute also necessarily sponsors diploma work.

"Later on, much depends on the young people themselves, on their advisers, and, finally, on chance. But here is what is important. As everywhere else, we have a Young Scientists' Council, scientific youth conferences are conducted, and at IONKh, these conferences are open and completely informal. By trial and error and with regard to our experience and that of other institutes, we arrived at what seemed to me to be the optimum principles upon which to base these conferences. Any young researcher can present a report on the work he has done. The jury rejects only finished dissertations; everything else is allowed: presenting reports, arguing a case, and debating, if necessary. I already mentioned that our conferences are open. This means that workers of other institutes may speak at them on a par with us. Last year, for example, first prize was won by Olga Gerasko from the Institute of Inorganic Chemistry of the Siberian Department of the Academy of Sciences, while the prize

of the head organization of the All-Union Chemical Society was won by T. Raykh, a graduate student from the GDR, working at our IONKh.

"I remember how hard it was to convene the first conferences of young scientists: there were few who were willing to participate; there were few who had the courage. But now, 30-40 reports are the rule. The prestige of the conferences has risen. What is important is that these conferences also teach young scientists how to present their projects clearly, how to prepare their illustrations sensibly, to not be thrown by unexpected questions, and to debate worthily.

"I think it is no accident that in the last 5 years, young associates of IONKh earned the Prize of the Lenin Komsomol for Science and Technology three times.

"There are problems, of course. But who doesn't have them?"

Beside the institute's conference hall, there stands a gallery in which portraits of IONKh chemists who earned Lenin, State, or Kurnakov prizes through the years are displayed. For the most part, these are degree-holding persons. With time, however, it cannot be doubted that this gallery will be supplemented by the portraits of some of those IONKh scientists I talked about with Andrey Bolshakov. There in the gallery, one reads the words of N.S. Kurnakov, which ring so true: "The task of studying and utilizing natural resources is extremely vast, and it requires the participation of all intellectual forces."

11004

UDC 536.46+541.27

Controlling Oxidation of Carbon Disulfide with Additions of Sulfur Vapors and Pilot Flame

18410475 Moscow KHIMICHESKAYA FIZIKA in Russian Vol 6, No 7, Jul 87 (manuscript received 13 May 86) pp 988-996

[Article by G.A. Bordakov, Institute of Problems in Mechanics, USSR Academy of Sciences, Moscow]

[Abstract] Controlling the dimensions of the laser-active zone within an optical resonator is an important aspect of continuous lasers which use the carbon disulfide oxidation reaction as a means for obtaining population inversions of CO molecules along their vibrational levels. One of the control methods consists of using jointly running chemical reactions which interact with the basic oxidation process by either promoting or inhibiting carbon disulfide oxidation. In the present work, a theoretical analysis is made of the promotion of the carbon disulfide oxidation reaction in very lean mixtures with molecular sulfur vapors and a carbon disulfide/oxygen pilot flame for the case of an ideal displacement reactor. Figures 2; references 12: 9 Russian, 3 Western.

12765

Kinetics of Hydrolytic Decomposition of Perxenate Ions in Acid Solutions

18410049a Moscow KINETIKA I KATALIZ in Russian Vol 28, No 4, Jul-Aug 87 (manuscript received 14 Jul 86) pp 984-987

[Article by L.A. Khamidullina, V.V. Rykova, D.D. Afonichev, and V.P. Kazakov, Institute of Chemistry, Bashkir Branch, USSR Academy of Sciences, Ufa]

[Abstract] The breakdown of xenon hexoxide in acid solutions produces xenon trioxide, oxygen, and water. The reaction is accompanied by chemiluminescence. The kinetics of the reaction are studied to determine the mechanism of the chemiluminescence. The perxenate ions are effective quenching agents for excited Tb(III) ions. Rate constants of quenching are determined, as well as the bimolecular deactivation rate constant, which is related to the oxidation of excited Tb(III) ions by perxenate ions. Kinetic fluorimetry is used to determine the rate constants of the very rapid process of electron transfer from Tb(III) to Xe(VIII) compounds, as well as the slower process of hydrolytic reduction of the compounds. Figure 1, references 9: 6 Russian, 3 Western.

6508

Magnetic Characteristics of Diamagnetic Garnets Doped with Trimeric Clusters

18410049b Kiev TEORETICHESKAYA I EKSPERIMENTALNAYA KHIMIYA in Russian Vol 23, No 4, Jul-Aug 87 (manuscript received 22 Oct 85) pp 462-464

[Article by M.I. Belinskiy, V.N. Kiselev, A.N. Men, and B.S. Tsukerblat, Institute of Chemistry, Moldavian Academy of Sciences, Kishinev; Institute of Metallurgy, Urals Science Center, USSR Academy of Sciences, Sverdlovsk]

[Abstract] A study is made of the magnetic susceptibility and spin heat capacity of a tri-nuclear system with $s=3/2$. The dopant centers with $s=3/2$ can be Cr, Mo, Al, or Gd ions, the latter two being isomorphically substituted in octrahedral a-positions of the garnet lattice. Even a slight biquadratic transfer significantly changes the magnitude and temperature dependence of inverse magnetic susceptibility. The conducted calculations attest to the fact that measurements of the magnetic susceptibility and low-temperature spin heat capacity of dopant atoms in diamagnetic garnet crystals allow trimeric clusters of transition metal dopants to be detected. The specificity of the $X^{-1}(T)$ (in the intermediate temperature $KT \sim J_o$ region) and c(T) (in the low-temperature region) dependencies allow the contributions of dopant pairs and triads to be separated out and the magnitudes of non-Heisenberg exchange reactions, in particular, the biquadratic exchange, to be evaluated. Figures 3, references 5: Russian.

6508

Photoelectric and Luminescent Properties of n-GaAs p-Al_xGa_{1-x}As Heterostructures

18410049c Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 4, Jul-Aug 87 (manuscript received 17 Jun 86) pp 87-89

[Article by Ya. Agayev, G. Garyagdyyev, Ye.V. Bragin, A.M. Demchenko, and A. Annayev, Turkmen Polytechnic Institute]

[Abstract] Semiconductor A^3B^5 solid solutions are widely used as sources of both laser and incoherent radiation. The photoelectric properties of the GaAs-Al_xGa_{1-x}As system make it suitable for registering light emission in the visible region. Liquid phase epitaxy was used to produce a p-GaAs layer sandwiched between an n-GaAs layer (alloyed with zinc) and a p-Al_xGa_{1-x}As layer. The gallium arsenide heterostructure's photoelectric current was studied as compared to spectra of luminescence excited in the heterostructure's narrow-band region, its electroluminescent spectrum, its volt-amperic and lux-amperic characteristics, and the dependence of emission intensity on current through the heterostructure. The electroluminescent spectrum with

direct connection of the heterostructure and a current of 100 mA contained one radiation band with a maximum at 0.88 micrometers, resulting from emissive recombination in the narrow-band region of the heterostructure. The dependence of emission intensity on current in the small current region was superlinear, and at higher currents, it was approximately linear. Studies of the volt-amperic characteristics showed that with direct connection of current, recombination was limited to the space charge region, but with the greatest shifts in current, its diffusion component predominated. The process of recombination in the space charge region of the p-n junction may explain the nonlinearity of the lux-amperic characteristics and the nonlinear dependence of emission intensity on current density. The regions of spectral photosensitivity and luminescence in the structures studied coincided. Figures 2, references 3: Russian.

6508

is soon thereafter removed from the list of those recommended for farm use on account of unfavorable toxicological properties. Such a state of affairs only slows down the development of Soviet pesticide chemistry.

The testing of new chemicals is not an end in itself. A definite policy should be pursued here. In selecting a chemical for State testing, it is necessary to consider the needs of Soviet industry: which chemicals, chemical forms, and technologies have a future in our country, which innovations should our specialists be made aware of? In this way, the State commission might approach the problems of the future assortment of chemicals.

But given the present organization, the commission cannot perform such work to the fullest extent. The geographical network of toxicological laboratories lacks the appropriate material-technical base. The staff is scarce, and their level of training is inadequate. Therefore, toxicological laboratories not infrequently send out chemicals for testing at farms where it is difficult to check whether the established procedures are being observed. The facilities of the VIZR are spread thin. Proposals were made to move the testing of preparations to institutes of the sector where there are competent staff and much experience, and it is feasible to evaluate the proposed protection agent with specific technology. With such an arrangement, the VIZR could exercise the functions of an executive organization, formulating the present-day flexible assortment of pesticides with better ecology, high effectiveness, and low use standards. At present, not even a superficial analysis of the findings is being conducted. The new regulations are simply entered into the list alongside the previous ones. How else can we explain the fact that when a higher use standard for certain chemicals is given for one and the same crop, the expected yield is lower?

No serious work is being done on the protection of produce in storage or the integrated protection of seed materials. Chemical analysis work on determining the dynamics of pesticide residues is behind schedule. The timeframe for preparing a list of chemical and biological agents for protection of plants against pests, plant diseases, and weeds, authorized for use in farming, and the supplements thereof, is seriously lagging behind practical needs. The list for 1986-1990, e.g., was issued only in the second half of 1986. The supplement to the 1987 list was delayed by the same amount of time. These documents appear when most of the protective measures have already been completed and the farms have sent in their requisitions for chemicals for the next harvest.

All of this shows that the work of the State commission is in need of reorganization. The necessity for this was discussed by the speakers at the plenary session. It was resolved to prepare proposals and to discuss them at the next presidium. And the first step in the new work style should be the 1988 supplement, ratified by the plenary session and ready by the start of the season.

12717

Natural Gas as Diesel Fuel

18410132a Moscow ADVANCES OF SCIENCE AND TECHNOLOGY in English No 10, 5 Apr 87 item 5

[Article by Dmitry Sasorov, APN correspondent]

[Text] The automobile, which came into existence 100 years ago, used first natural gas and then gasoline. At that time, the latter was bought in pharmacies like drugs. But with the end of the gasoline shortage, the automobile itself became the main polluter of the environment. Today this problem has acquired an international scope.

So far, there is no engine which can be called absolutely clean in an ecological respect, although intensive research in this direction is carried out in many countries. But even now the automobile's ecological harmfulness can be reduced. In the first place, if natural gas is used instead of gasoline or solar oil. Such gas is cheap and does not call for design changes in existing engines.

Until recently, natural gas was used only in carburetor engines. The world automobile fleet is represented to a large extent by diesel vehicles of medium and large cargo-carrying capacities. In the Soviet Union, they are turned out in Kremenchug, Minsk, Zhodino, Mogilev, Brezhnev, and Mias. Their output has been started in Minsk, Gorky, and Kutaisi. These vehicles use solar oil which, like gasoline, is a petroleum product, i.e., a valuable raw material of the chemical industry.

In the recent past, all attempts to switch diesel engines over to natural gas failed because diesels used a principle of operation where the fuel-air mixture burns only as a result of strong pressure. A diesel has no spark plug, and it was believed that without this it would be impossible to ignite the natural gas. The law of nature is valid now too. It cannot be violated, but, as research has shown, it can be obviated.

This has been done by scientists and engineers from the Moscow-based Automobile and Engine Research Institute (Russian abbreviation NAMI). They have created equipment by which the engine is started when a purely diesel mixture is used. As soon as the engine is heated to 40 degrees C, natural gas, not solar oil, passes through a heat exchanger and is delivered to the cylinders.

At a Moscow trucking firm, the Czechoslovak AVIA-30 van was switched over to natural gas with the help of NAMI's specialists. The Kama Auto Works—the largest manufacturer of diesel trucks in the USSR and in Europe—is preparing the output of diesel trucks which use natural gas.

The All-Union Research Institute of Railway Transport is also creating a natural gas diesel engine. Specialists at this institute are experimenting with a shunting diesel locomotive with a capacity of over 1,000 HP, the engine of which operates on a mixture of solar oil and natural gas. Liquid fuel serves here as an igniter. However, it is planned to compel the diesel to operate on pure natural gas, but this requires electronic ignition.

So far, only a pilot sample is in existence. Over a few months it is to answer the following questions: What are the traction potentials of natural gas? Has the system of supplying gas in variable modes been determined correctly? How can the safety of the locomotive's operation be achieved, taking into account that natural gas is explosive?

The Leningrad River Navigation Service has started similar work with diesel engines. Leningrad, often called "northern Venice," is situated on islands. It is criss-crossed with canals and has hundreds of bridges. The city is a major sea and river port. Therefore, Leningrad water routes are polluted with the waste of petroleum products. Slicks from the water surface are collected by cleaning launches provided with diesel engines. But the latter pollute the air with exhaust. Therefore, it has been decided to switch launches over to natural gas. Tests of the first such craft are now under way on the Neva.

Natural gas as a motor fuel surpasses gasoline. Its octane number is 10 units lower than that of the best gasoline varieties. Natural gas engines' service life is 50% longer, and their oil consumption is 50% lower. And yet for a long time, natural gas could not compete with gasoline because its density is 1,000 times lower. Today natural gas is compressed to 250 atmospheres by placing it into metal cylinders. Thus, natural gas, which opened the history of automobiles, has again come to transport.

/06091

Intensification of USSR Oil and Natural Gas Production

18410132b Moscow ADVANCES OF SCIENCE AND TECHNOLOGY in English No 27, 25 Sep 87 item 1

[Text] Oil and gas are key factors of the Soviet fuel and energy pattern, although the leadership is increasingly passing on to gas.

Natural gas accounts for 35% of the national output of energy resources, which is 100% more than 15 years ago. In 1990, the Soviet Union is planning to produce 8 0 billion cubic meters of gas—a 200 billion increase over the 1985 production level.

Accounting for a third of the world gas output, the Soviet Union has established itself as an indisputable leader in the field and boasts the world's highest growth rates ever since the early 1970s.

The situation is different in oil production. Until recently, growth rates in this industry were almost as head-spinning as in the gas industry. Beginning with 1950, oil production in the country steadily increased at the rate of 20 to 30 million tons a year, whereas today, this

growth rate is a planned target for a whole five-year period (1986-1990). Growth rates are being frozen in the industry. In 1985, the country produced 595 million tons of oil and gas condensate. In 1990, it is planning to produce 630 to 640 million tons. This will be, probably, the output maximum for years to come.

Why such modest planned targets? Is it proof that oil reserves are almost depleted in the country that has been the world leader in oil production since the mid-1970s?

Says Vladimir Filanovsky, First Deputy Minister of Oil:

"The age of 'golden' oil gushers has passed, never to return. But we are not going to give up our leadership in this field. Today, the industry has a reserve of raw materials for several five-year periods to come. Regarding the slowing down of growth rates, the reason is not the depletion of deposits, but recovery problems."

The past successes could be credited chiefly to geologists. After the discovery of major oil deposits in the Urals and the Volga Region, the discovery that gave the first impetus to oil production, they found uniquely rich deposits in Western Siberia. Every local well there could produce almost as much as an old oilfield in traditional production areas. Largely due to this, today there are 50,000 tons of cumulative production of oil per oil-producing well in the Soviet Union. In the United States, the figure stands at 10,000 to 15,000 tons. The average well flow rate in the USSR is eight times that in the United States.

This unusually generous gift of nature has been the reason for an unprecedented leap forward, in time and scale, for national oil output in the USSR.

In the past few years, however, Soviet geologists seemed to have run out of luck. The growth of prospected oil reserves was ensured mostly by small deposits that are difficult to develop by conventional methods. Since 1960, the share of such deposits, which amounted to 10 percent then, has grown by 4.5 times.

"The possibilities of finding major deposits have not been exhausted. We pin great hopes on the Arctic shelf, Eastern Siberia, and other regions, in which intensive prospecting is under way. But judging by scientific forecasts, the quality of oil will deteriorate. This factor will have a decisive role to play in our plans for the future," Filanovsky continues.

More than 70% of the current oil output comes from a mere 5% of deposits. Of the 300 deposits discovered in Western Siberia, only 78 have been put into operation so far.

"This 'proportion' will not be tolerated for long," Vladimir Filanovsky observes. "Oil production at old deposits is gradually declining, which is an inevitable process. Intensive efforts are being made now to start up low-productivity deposits with complicated mining and geological conditions."

Such changes in the primary base in the oil industry give rise to a number of engineering and economic problems. First, an ever increasing amount of oil is used to compensate diminished output at traditional fields. As a result, 90% of all capital investments are spent to maintain the existing production level.

This inevitably leads to reduced efficiency of newly started-up wells. They cannot compare to the gushing wells at the dawn of the West Siberian oil industry. Today, to produce the same amount of oil, it is necessary to drill a much larger number of wells.

As a result, considerable structural changes in oil production will be made. Development wells are being intensively transferred to mechanized oil recovery, which will replace the natural flowing recovery method and is particularly effective on low-density oil deposits. This method is based on Soviet-pioneered technology of water injection to build up reservoir pressure. This method accounts today for 90% of Soviet oil output.

Transfer from the natural flow to the mechanized production method gives rise to an ever growing demand for highly reliable and efficient equipment. To cope with this demand, a special comprehensive program has been launched in the Soviet Union along with several others that have been designed to resolve oil production problems.

Science and technology are regarded in the Soviet Union as principal means of implementing another important program that provides for the rational exploitation of oil resources. Although the Soviet Union has set the world record in the oil recovery factor, a lot of oil is left in deposits. The current intensification policy sets the task of raising the recovery factor by 10 to 15% through new technology, to be used, first of all, at old fields in order to give them a new lease on life.

The current Soviet program for integrated industrial development schemes is unlikely to bring about radical changes in the existing situation in the next decade. Approximately 80% of consumers are still based in the European part of the country, while more than 75% of hydrocarbons have been located in northeastern regions. This gives rise to transportation problems.

The world's biggest unified gas-supply network is in the USSR. It incorporates 170,000 kilometers of pipelines, stretches for 5,000 kilometers from east to west and for

3,500 kilometers from north to south, and encompasses practically the entire territory of the country. In addition, there is a 63,000-kilometer-long network of trunk oil pipelines.

But even this giant system that looks after the needs of not only Soviet, but also foreign customers, including some socialist countries, West Germany, France, Italy, and Austria, is not the limit. Plans are to start up, over the next few years, another six thousand kilometers of oil pipelines and the 4,600-kilometer Yamburg-Soviet Western Border Gas Pipeline which is a joint project of CEMA countries. It will further build up the USSR's gas export potential, which in the past 15 years has grown by 20 times.

The average range of gas delivery has lately increased by 1,440 kilometers. The longer the range, the more money is required. Siberian gas, which is one of the cheapest and most efficient fuel grades, loses a considerable part of its advantages on its long voyage to customers. The problem is further aggravated by the growing loss of gas at compressor stations. Taking into consideration the projected scale of gas transportation to the West, experts claim that losses through pumping will double every five years and will reach 100 million tons of conventional fuel in the not too distant future. It is natural, therefore, that the engineering policy in the field of gas transportation focuses on the means of reducing non-productive hydrocarbon losses.

Very promising in this field is a method of concentrated gas flows which could be achieved by increasing the diameter of pipelines to 1,420 millimeters and the working pressure to 75 atmospheres. Such pipes are now produced in the Soviet Union en masse. Pipelines made of such pipes are two times more productive than conventional 1,220 mm pipelines and consume one-third less metal.

The obvious advantages of the method of gas concentration in a single technological corridor, in which the flow capacity could be increased to 250,000 million cubic meters, should not make us blind to the very likely possibility of a sudden interruption of gas delivery as a result of failure of a single pipeline. Therefore, the most important task is to ensure maximum reliability, which could be achieved through a perfected automated control system with the tasks of monitoring the entire technological chain from gas recovery to delivery.

"The drive toward intensification and modernization improves the prospects of the oil industry," says Vladimir Filanovsky.

/06091

Natural Gas: Emphasis on Comprehensive Utilization

18410181 Moscow ADVANCES OF SCIENCE AND TECHNOLOGY in English No 29, 15 Oct 87 item 5

[Article by Yuriy Bokserman, doctor of technical sciences]

[Text] Natural gas is a major element of the USSR's energy balance and is ever more widely used to replace oil as fuel. Compared with 1980, the proportion of gas in the total output of energy resources will increase from 26 to 33% by the turn of the 21st Century. At the same time, the sharp increase of the role of natural gas as a motor fuel as well as a source of valuable liquid hydrocarbon fractions, a sizeable part of which will be used to switch automobiles over to work on gas (the butane-propane fraction), is a specific feature of further development of the USSR's gas industry. In the USSR, natural gas is considered to be a comprehensive raw material needed not only as fuel and a source of energy, but also for the petrochemical and chemical industries. In this connection, gas refining, which makes it possible to obtain sulfur, helium, and other substances, will develop.

The Soviet Union has sizable reserves of gas which make it possible to reliably forecast the growth of its output (including casing-head gas) to 835-850 billion cubic meters in 1990, with further growth in the long term. The development of the gas industry is ensured by prospected deposits (Western Siberia, where the large Urengoy and Yamburg deposits are located, is the main supplier of natural gas in the USSR). But it is also planned to carry out large-scale work on prospecting new gas deposits. In the next few years, geological prospecting work will be concentrated in traditional and new areas, among them Western and Eastern Siberia, the Caspian depression, the Central Asian Republics, and on the sea shelf. Special mention should be made of plans to prospect deep levels, above all in the Caspian depression, in which it is planned to drill quite a number of wells with a depth of 6-7 km and more.

Use of Natural Gas as a Motor Fuel

In the USSR, work to substitute gas compressed to 20 MPa and liquefied oil gas for oil motor fuel (gasoline and diesel fuel) in automobile, railway, river, and sea transport is being carried out. Over 170 stationary automobile gas-refueling stations of different capacities which perform 75 to 500 refuelings a day have now been built. They service over 120,000 trucks, and it is planned to bring the fleet of automobiles running on natural gas to one million by the year 1990. To this end, a ramified network of gas-refueling stations is being set up in all towns and large settlements of, in effect, all Union republics. The production of compressed gas automobiles, buses, and special common-carrier vehicles,

including not only those with carburetor but also diesel engines running on the basis of a natural gas-diesel cycle (70-80% natural gas and 20-30% diesel fuel), has been organized.

It is relevant to say here that not only stationary gas-refueling stations but also mobile ones for non-compressor refueling of automobiles, tractors, locomotives, and ships with high-pressure (20 MPa) natural gas, stationary and mobile liquefied-gas tanks, and stations for refueling automobiles with medium-pressure (up to 5 MPa) gas directly from trunk pipelines have been developed in the USSR. It is envisaged to develop a network of centers for servicing vehicles running on natural gas.

Research has shown that automobiles running on natural gas produce much fewer emissions of noxious substances than those working on gasoline (4-8 times less carbon monoxide and 2.5-3 times fewer nitrates). Furthermore, experience from operating compressed gas vehicles has shown that running on natural gas increases the service life of an engine by approximately 1.5 times and reduces the consumption of motor oil by 30-40%. One refueling is enough for a truck to cover 200-250 km and a car, 200-300 km.

Block-container gas refueling stations will be built in the USSR in 1988-1990. In this case, all assembly work is done at the machine building plants, while only installation of prefab blocks and construction of outer networks will be carried out at sites chosen for the stations. This will reduce construction time by 3-4 times and capital investments by at least 20-25%.

The construction of garage gas-refueling stations, which will make it possible to do away with wasted automobile trips, will be carried out on a large scale. The mobile natural gas tank trucks, which will bring fuel to auto pools in the morning, will serve the same purpose. One tank truck of this kind can refuel 40 trucks and up to 100 cars during one trip.

The fulfillment of the large-scale program of switching motor transport over to natural gas will make it possible to save many millions of tons of oil motor fuel. Experimental work on switching tractors, locomotives, and river and sea vessels over to gas is being carried out in the USSR.

Natural Gas Refining

As is known, natural gas is a comprehensive mineral raw material, containing, apart from gaseous hydrocarbons of the methane type, liquid paraffin, naphthene and aromatic hydrocarbons, hydrogen sulfide, nitrogen, helium, and other elements. Many components of natural gas and of the condensate which it contains are valuable raw materials for producing ethylene and benzene. For instance, the output of ethylene by pyrolyzing ethane exceeds its output by pyrolyzing the benzene fractions of primary oil refining by 2.5-3 times.

Gas refining has already become one of the main sources of high-quality sulfur for the national economy. The gas industry accounts for, in effect, the total output of helium in the USSR. It also produces gas condensate.

The first phase of the Astrakhan Plant has been put into operation. Gas from the Astrakhan deposit with a hydrocarbon content of up to 25%, condensate—300-400 cubic cm/cubic m, and ethane and propane—up to 5%, serves as a raw material for it. The second phase of this plant is now under construction. The Orenburg and Mubarek gas refineries, the largest in the world, have been built in the USSR. And new large gas-chemical complexes will be built in the near future. Putting them into operation will considerably raise the effectiveness of the gas industry and provide consumers with valuable petrochemical products.

Non-traditional Gas Resources

In 1970, Soviet scientists discovered a new type of fuel and energy resource in the sedimentary cover of the earth's crust. These are ice-type compounds of natural gas (methane) with water, the so-called methane hydrates. According to calculations by Soviet and American scientists, the earth's reserves of methane in hydrate-formation zones exceed by orders of magnitude the aggregate resources of all other known types of combustible minerals. And the estimated recoverable reserves of this fuel on land and in water areas of the USSR amount to scores of trillions of cubic meters. Experience in developing gas-hydrate resources has already been accumulated at the Messoyakh deposit in Eastern Siberia.

A sizable part of continental gas-hydrate deposits can and must be developed through the use of the well-known technology of gas extraction, accounting for specific features linked with the need to break down hydrates into gas and water in stratum conditions. New technological processes, the scientific principles of which have been developed by Soviet researchers, will be needed for deposits on shelves and continental slopes in water areas. These principles have been recognized and further developed in other countries.

The task of prospecting gas-hydrate deposits in areas of the USSR with the most promise has now been set. The list of such areas on the continental USSR includes, specifically, the northern area of the West-Siberian oil- and gas-bearing province, the territory between the Lena and Yenisey Rivers, and some parts of the Pacific coastal zone of the USSR. The hydrate-formation zones of the Sea of Okhotsk and the Bering, Black, White, and Barents Seas are the most promising for priority development within the 200-mile economic zones of the seas bordering the USSR. Parallel with headway being made in geological prospecting and exploration work, gas-hydrate deposits of other seas adjoining the USSR's borders will be developed.

/06662

Scientific and Scientific-Organizational Work of Gas Institute

18410089 Kiev VESTNIK AKADEMII NAUK UKRAINSKOY SSR in Ukrainian No 11, Nov 86pp 3-5

[Text] Some findings by the Presidium of the UkSSR Academy of Sciences, after examining aspects of the scientific and scientific-organizational work of the Gas Institute for the period from 1982-1985, were described and discussed. Some significant achievements were noted. These included fundamental and practical achievements in areas of hydrodynamics and mass exchange during low-temperature separation of gas and condensate, creation of a scientific base for automated design of gas transport in main pipelines, optimization of heat exchange in metallurgy industry furnaces, mathematical modeling of chemical processing of hydrocarbons, creation of effective air pollution control, and others. Measures for improving operational and personnel activities were discussed briefly. Many deficiencies in operation were listed. These included inadequacies in basic research and design work and in introduction of energy-saving technology, failure to change the direction of scientific research to meet present needs, failure to accelerate scientific progress, and others. All these inadequacies applied, first and foremost, to problems related to the use of natural gas as a motor fuel. Inadequacies in personnel training and placement, especially of advanced graduate students, were mentioned. Measures required to remove or improve these inadequacies were described and discussed.

02791

Problems in Developing New Fuel for Diesel Engines

18410128 Tashkent PRAVDA VOSTOKA in Russian 17 Nov 87 p 3

[UzTAG — Special for PRAVDA VOSTOKA, entitled "From What Should Diesel Fuel Be Prepared? Why Not Use a New Fuel Reserve?"]

[Text] Petroleum chemists of Uzbekistan are ready to start industrial production of a new motor fuel developed at the Tashkent Highway Institute. Even now, in the current year, this fuel could be used to service the entire diesel transportation needs of Tashkent. But...

Official Work Expeditor, Candidate of Technical Sciences Docent E. Pyadichev relates as follows:

"Essentially, the new fuel is a condensate, derived jointly with natural gas. The feasibility of fueling diesel engines with condensate has been proved with 20 years of research. Over 1000 trucks, tractors, drilling rigs, and electric power plants have been operating on condensate."

"Twenty years...Quite a long time, no?"

"Habitual, by the standards of the sadly remembered stagnation times; inexcusable, by the standard of acceleration. The new fuels have passed all necessary and unnecessary (much more of these) stages of 'introduction' from unacknowledgment to industrial production. They have been authorized for use in regions contiguous to the oil fields of Central Asia and the Northern Territory."

"What are the merits of this fuel?"

"In the first place, it helps to relieve the fuel shortage by substituting for the more economical diesel engines. Second, it reduces by half the amount of harmful pollutants to the atmosphere, especially carcinogens.

The latter is especially important for Tashkent, where due to poor cross ventilation on certain highways, pollution with carcinogens exceeds the maximum allowed by tens of times."

"The solution is obvious..."

"And it has been done. On request by the Uzbekistan government. Gosstandart SSSR authorized use of gas condensate fuel (GKT) in Tashkent, where there are tens of thousands of diesel vehicles. This would drastically alter the ecology of the city with a population of two million...."

"But it didn't change anything?"

"Alas, not yet. You see, the condensate produced from the well must be transported in clean railroad tank cars, although it is frequently transported in tank cars used for crude oil. However, such a product can be used at the refineries without retooling. Simply stated, one valve is turned on, another turned off. The technology has long since been tested at the Altyarykskiy Refinery. But matters stand still."

"Why?"

"Two changes must be made in the technical agreements. These changes will not go beyond the limitations of the standards, nor will they be reflected in engine operation. However, 'good will' is required amongst seven organizations. The negotiations have been dragging along now for two quarters. During this time many tons of soot and carcinogens have been emitted into the air of Tashkent.

"However, we are hoping that soon the residents of Tashkent will be breathing cleaner air: the negotiations seem to be coming to an end.

"New problems are arising, however. For example, they suddenly started to deliver a different composition to the Altyarykskiy Refinery with a higher sulfur content. Now, we must either re-negotiate the agreements or strive for this refinery to receive stock from previous oil deposits.

We think that the second alternative is more logical: after all, both oil deposits are located in Uzbekistan, and the question can be decided locally."

"It all seems quite clear; why refine fuel at a refinery when it can simply be taken from underground?"

"We look upon this as a temporary solution; the air in Tashkent is in urgent need of attention. Generally speaking, of course, where is it cheaper to obtain GKT from the oil field directly, for example from Shirtana. Even now, simple units are being built in Central Asia for treating the condensate on site.

"However, more must be worked out for the broad usage of Shirtana condensate: it contains substances suitable for service not only in diesels, but also in carburetor engines. Our institute is now conducting research together with the UkSSR Academy of Sciences. If we are successful, it will be possible to separate the condensate into two fractions right at the site: one for carburetor engines, the other for diesels. It is true that the fuel will have a slightly lower viscosity than that required by the technical agreements. But let us not get bogged down in the slime of the negotiations..."

"For another 20 years?"

"Well, hardly. However, the fruits of procrastination are at hand. The theme entered into the plan for the previous Five-Year Plan is not in the present one. For this reason, 'volunteers' were found introducing GKT independently: 'Uzavtotranstekhnika' and 'Soyuzuzbekgazprom.' Independence did not lead to good will; it can only interfere with concluding the research. Twenty years of experience states: having endured failure, the 'volunteers' will blame us, the innovators, as before.

"Generally, the stagnation and sluggishness of the existing system, where various departments work on a single problem, has become especially clear. Let us say, for example, that funds must be provided for a laboratory, working under the Ministry of Transportation of a republic, to organize refining and delivery of fuel and to coordinate this with other departments. The Ministry of Transportation is not authorized to finance such operations, and the Minvuz lacks money. Experience has shown that a far-reaching special purpose program fails to enter the plans of the appropriate ministries, and the initiator seeks 'with an extended hand' for money wherever he can get it."

"But the current restructuring of management will allow all of this to be solved...."

"Yes. Work must be built not on the basis of managerial agreements, but by financing a theme from the State Budget on a self-financing basis. Recent statements by M.S. Gorbachev on the problems of economic efficiency in science refer directly to us, the creators of new types of fuel. Total cost-accounting on the part of a collective involved with GKT would make it possible to finally break the ring which has encompassed the most important problems of the national economy for 20 years.

"We are impermissibly losing time, which in this case means not only money, but also the health of hundreds of thousands of Soviet people."

12765

Polymers in Contact with Living Organisms

18410024a Moscow KHIMIYA: POLIMERY V KONTAKTE S ZHIVYM ORGANIZMOM (Novoye v zhizni, nauke, tekhnike [New Developments in Life, Science and Technology]. Ser. "Khimiya") in Russian No 8, Aug 87 pp 1-3

[Annotation, introduction, and table of contents from book "Polymers in Contact With a Living Organism," by Nikolay Alfredovich Plate, corresponding member of the USSR Academy of Sciences, doctor of chemical sciences, professor, director of the Institute of Petrochemical Synthesis imeni A.V. Topcheyev of the USSR Academy of Sciences, and chairman of the Scientific Council on Synthetic Polymers for Medical Purposes of the USSR GKNT [State Committee of the USSR Council of Ministers for Science and Technology], and Lev Ivanovich Baluyev, doctor of chemical sciences, senior scientific associate of the above institute, Izdatelstvo "Znaniye," 48 pages]

[Text] ANNOTATION

Medicine has become one of the new fields of use for polymers, which are designated for long or short-term contact with the tissues of a living organism. The use of these substances provides a therapeutic effect, differing qualitatively from the action of low-molecular weight or other compounds traditionally used in the past. In connection with this, studies are being made not only of the physicochemical properties of polymer materials, but also of the conditions for introducing them into an organism.

INTRODUCTION

Scientific-technical progress leads to ever-increasing erosion of the traditional boundaries between fields of fundamental science. As experience shows, it is precisely at the juncture of classic scientific disciplines that new directions arise, leading to the most significant progress in the development of society's productive forces. Serving as a striking example of this is the origin and rapid development of the chemistry of medical-biological polymers, which arose at the meeting-point of organic chemistry, chemistry of high-molecular weight compounds, biochemistry, molecular biology, pharmacology, and medicine. Interest in this area of science is dictated by two circumstances: by the fundamental aspects of one of the global problems of modern natural science—interaction of the living and the inorganic—and by the extremely important practical results stemming from the most varied applications of synthetic polymers in medicine and public health.

We are not speaking of supplies for sanitation and hygiene, containers and packaging films for medicines, or various devices for one-time use, even though over 90% of the polymers designated for medicine are consumed for these precise purposes, i.e., items used outside the human body. All these items have already entered the practical work of hospitals and clinics, although it is not obligatory that they always be made from synthetic polymers; the last word here, ultimately, goes to economy and convenience in use. The subject of the chemistry of medical-biological polymers consists of synthetic substances and materials intended for long or short-term contact with the tissues of a living organism and providing a therapeutic result which differs qualitatively from that of using low-molecular weight substances or other substances and materials traditionally used in the past.

The appearance of any new substance, product, or technology always arises from the necessity of satisfying some of society's needs. This was the case with polymers for medical purposes. As is noted in numerous works, accumulated surgical experience showed that the use of polymer materials in certain surgical procedures was justified, and in some cases is a necessary condition to achieve a positive result in the operation. Achieving these results requires not only synthesizing special material and constructing and preparing an article from it which fulfills the function of a certain organ or tissue, but also working out a methodology for performing the operation of implanting (embedding) this article in the living organism. The effect of the polymer material on important vital processes must be studied, as well as all aspects of the effect of the organism itself on this polymer, including aspects such as biological destruction of the polymer, the fate of the polymer and the products of its metabolism in the living organism, and many others. A new field of science—the chemistry of medical-biological polymers—is called upon to solve all these unusually difficult and important problems.

TABLE OF CONTENTS

12151

Minister Discusses Industrial Rubber Products

18410024b Moscow SOVETSKAYA ROSSIYA in Russian 27 Aug 87 p 1

[Interview with N.V. Lemayev, USSR Minister of the Petroleum Refining and Petrochemical Industry, by P. Kharitonova and S. Brusin: "The Gordian Knot of a Rubber Belt," date and place not given, first paragraph is a letter to SOVETSKAYA ROSSIYA, second paragraph is SOVETSKAYA ROSSIYA introduction]

[Text] "I have been working with equipment for a long time, and I know which machine not to take and that rubber parts are the first to let you down. Let us say, even

new sealing rings leak oil on the tractors. And we change the V-belts on the grain combines before every harvesting. On the other hand, the same things, imported, serve for about five years. Will you explain why we lag behind this way?"

S. Krylov Machine Operator Ryazan Oblast

The reader's message was directed to N.V. Lemayev, Minister of the USSR Petroleum Refining and Petrochemical Industry.

[Answer] The fact of lagging behind must be admitted. But let us analyze it: lagging behind—in what, precisely? Yes, sometimes the industrial rubber items used in mass equipment and in everyday life are unsatisfactory with respect to their qualitative level. At the same time, in the last five years, our scientific research institutes have sold abroad 12 licenses for new materials and designs. This is more than in a number of other sectors. These are world-level products: the parts are capable of withstanding an extremely broad range of temperatures and load conditions and the action of any corrosive medium.

Since reader S. Krylov mentions belts, I shall speak specifically of them: a so-called cord design, new in principle, which has twice the service life of belts, has been developed, as well as the technology to manufacture them. The new belts surpass even their foreign counterparts with respect to quality.

Thus, everything looks all right on the whole at this stage of scientific research. The problems arise on the path to introducing it. Many of our promising developments are put into practice only in small series for special orders. But mass products—gaskets, packing glands, and sealing rings—often break down without having served out their warranty period.

The root of the evil can be seen even with the naked eye—there is a great gap between advanced scientific thought and mass production. This gap was programmed by the strategy formed in the sector during the last decade.

[Question] What do you have in mind?

[Answer] In the last few years, many enterprises have essentially discovered rubber for themselves. It has begun to be used not only in the traditional areas—machine building and water resources—but also in metallurgy and medicine. All this has had an effect on the unprecedented growth of production volumes of items made from rubber. Judge for yourselves. The conveyer belting produced in a year can stretch halfway around the equator, and it can be encircled twice with the rubber hoses that we have produced. Some 2.5 billion rubles worth of "kopeck" gaskets, packing glands, sealing rings, and other items are being produced. Unfortunately, the sector was not yet ready for such a leap in the production volume. Not even the fact that the fatigue life of industrial rubber items has doubled in the last few years has saved us. After all, the volume of orders has had a much greater rise. Equipment is becoming increasingly "rubber-saturated." Let us say, there are almost three times more rubber parts in the Don-1500 combine than in the Niva combine.

The demand is inexorably outstripping the supply, and the shortage is making both the consumers and the manufacturers feverish. The ministry did not succeed in evaluating the situation in time. Submerged in the solutions to innumerable operational problems, it made no attempts to analyze the future nor to work out strategy. Both our plants and our consumers have paid for this with billions in losses.

Can six times more equipment than provided for by the plan be installed in a production shop? Of course not. The workers at the "Kurskrezinotekhnika" Production Association, however, have these precise conditions. At other plants, too, as they say, there's not room to swing a cat. The order curve continues to climb steeply upward—how can they keep up with it!

Defective products in mass production are to a great extent the result of an overstressed production race. In world practice, in order to adhere carefully to the temperature schedule, the pressure, and other technological parameters, not over four or five items are stamped at the same time on one plate in the presses. But in our country—up to 100, or else the purchasers will start up conveyers.

The quality suffers not only from the volumes, but also from the assortment, the product list. Machine builders take little trouble to standardize the assemblies of their mechanisms and machines, and thus the assortment of industrial rubber items is too broad. There are 100,000 types of shaped items alone! This is an unthinkable, astronomical number. The element of the assortment is overwhelming: the "Balakovorezinotekhnika" Association produces 9 million different parts per day. There is probably no other such example in the world.

The drama of the situation lies in the fact that, by accepting requisitions from each of the purchasers, the sector has seemingly turned into a mechanical aggregate, executing a tremendous number of orders, many of them duplicating each other with slight variations. This is extremely inefficient. The scale of duplication is paralyzing development.

The impasse and hopelessness in the sector's development, automatically ensuing from the orders, should have been foreseen in advance. In this lies the miscalculation in the prediction, made at the end of the 1970's and the beginning of the 1980's.

Today we should give the mass consumer good rubber—there is no more important task. Therefore, we are introducing a fundamentally different mode of action in the sector: to proceed not from the next order in turn, but to work out, assimilate, and series-produce thoroughly standardized series of uniform items. Will the interests of the consumers be infringed upon by doing this? No, on this basis we can fulfill the most varied of their orders. On the other hand, the economic nature of large-series production, the acceleration of scientific-technical progress, and the concentration of forces on raising product quality will all increase many times over.

[Question] By standardization you will curb the element of assortment and raise the quality of large-series production. But won't there still be a demand for experimental batches of parts and single orders?

[Answer] Here too we are sharply changing the approach. A related sector is prompting the solution. Chemists are producing granulated raw material from which the consumers themselves make items out of plastic. There are sections of this type for processing plastic at many machine building and other enterprises that are far-removed from chemistry.

This same production system is also possible when applied to industrial rubber items. These perspectives are opening up development for us in the sphere of thermoelastic plastics. Thermoelastic plastic is a material based on a new principle — possessing the properties of rubber, but processed according to the technology of manufacturing plastic without the labor-intensive process of vulcanizing. This makes it possible to pose the question of organizing a small production section at any plant in the country, with any departmental affiliation. It is seen as a unique module, absorbing advanced technological approaches and presupposing automation, good working conditions, and high product quality. The task of our scientists and engineers is to work this project out completely in the near future.

This will make it possible to solve the problem of small series on a statewide scale. Most of the purchasers will be interested in organizing their output themselves, strictly for their needs. Under the conditions of cost accounting, this will again be turned around as an economic advantage for them. Our sector too will thus be relieved of innumerable trivial orders and will concentrate on problems of the quality of a product list of national economic significance.

First of all, the technological provision of the plants must be raised. It has lagged behind today's demands: working conditions are unfavorable, and half the operations are manual. The extreme conditions of a rapid growth of production volumes and oversaturation with equipment have required the outstripping development of technology and good engineering decisions, but in reality? At the leading technological institute, VNIKTIRP [All-Union Scientific Research and Engineering Design Institute of the Rubber Industry], the proportion of its own technological developments in 1985 was only 16 percent.

At present, we have taken on the active introduction of a number of new industrial processes such as rotary lines and powder technology. These innovations require new equipment: in three years, machine builders will receive 160 such technical assignments from us.

[Question] The problems of the sector that you are talking about did not originate yesterday. They are chronic in nature. One of the reasons for this situation has been named—errors were made in prediction, and the strategy for developing the sector was determined incorrectly. But why did the consumer-enterprises not sound the alarm promptly?

[Answer] The imperfection of the economic mechanism had an effect. As was noted at the July (1987) CPSU Central Committee Plenum, the relationship of the producer to the consumer is very important. This tie stimulates better performance from the workers in the sector. Unfortunately, in the industrial rubber product industry, this principle has been violated for a long time. It has many purchasers, but they are not as a rule consumers, and this is the essence of the matter.

Our items are mainly unit-completing ones for a motor vehicle, combine or industrial equipment. The worker or agricultural machine operator does not receive our product, but an assembly or mechanism, inside of which there is a gasket, belt, or hose. Accordingly, they direct the claims, in case of a defect, to the supplier of that assembly or mechanism. This signal does not always reach our sector.

Why? The machine building ministry, let us say, receives a poor-quality belt from our enterprise—and should immediately send a complaint, not accept the defective item. But since it is not the consumer, the defective item does not particularly affect its interests: it has put this rubber part in place and sent the entire item on—to the final consumer—and, the main thing, it has been accounted for on the plan. If, however, reasons our purchaser, on the contrary, it finds fault with the quality, there is the risk that its own plan will not be fulfilled. Here it is, the mechanism, making the sector for industrial rubber items and its numerous purchasers seeming accomplices in reducing the quality requirements, pushing them to a mutual "amnesty."

We are now restoring an atmosphere of exactingness in the sector. What do we still have to combat? Many seem to be held captive by the "kopeck" cost of a gasket: these are losses from defects, they say. But a gasket becomes truly golden, if a combine or excavator has to be taken apart from top to bottom, under field conditions, to replace it. And translated in terms of the country's entire economic system? The old economic mechanism made it possible to cover up losses due to defective industrial

rubber items, and therefore, in the sector, for decades, they calmly looked at the intensifying of crisis and stagnant phenomena in science, technology, and product quality. At the same time, the ultimate consumers, foreseeing a defective product in advance, increased their actual need by a third in their orders for parts, engendering a still greater overload and disruption for us.

Cost accounting relations between enterprises and sectors and throughout the economic system will cut the "Gordian knot." The feedback expressed in the ruble will arm the enthusiasts in the sector—and we have quite a few—in the struggle to develop articles equal in strength to the mechanisms for which they are intended, which both the driver and the machine operator expect from us, for mass series production to emerge at the level of world achievements. It is precisely this order for producing items that the country is giving us.

One last thing. Returning once more to the letter from the reader S. Krylov. I have already said that a new design for a belt has now been developed. This time he will not be forced to wait for their mass output—the belts have already gone into series production.

12151

UDC 678.5.061.62.001.5"313"

Trends in Research and Development at NPO "Plastmassy"

18410470a Moscow PLASTICHESKIYE MASSY in Russian No 7, Jul 87 pp 3-4

[Article by V.I. Goldbert and Ye.S. Botvinnik]

[Abstract] The interplay of science and industry has special significance in modern day development of the national economy, and in this respect, responsibilities of sector organizations in improving R&D and its application in production continue to grow. "Plastmassy" is a major scientific production association (NPO), and its activities are directed toward raising the technical level of production facilities by utilizing more effective engineering processes, by improving the quality standards of products, and by developing and introducing new polymers and materials based on them which could accelerate progress in all branches of the economy, but especially in the power, machine, and tool building areas. During the current and future Five-Year Plans, "Plastmassy" will achieve quality changes in the production of synthetic resins and plastics, especially structural thermoplastics, ionites and membranes, polymers for composite materials, etc. At the Institute of Plastics imeni G.S Petrov, which is the head unit of the Association, a bank for promising research themes is being developed by conducting contests for ideas. Two such contests have been held which resulted in the selection of proposals for the most urgent and promising themes for exploratory research. Over 50 long-range proposals were developed, outlining possible research paths for creating a new generation of polymers, materials, and means for their production. Procedures for these proposals will be developed in cooperation with the Scientific-Procedures Center of the Okhtinsk NPO "Plastpolimer," and a complex program for work on new processes and materials has been established for the period up to the year 2000. Within this program, for each new polymer, oligomer, or plasticizer developed by "Plastmassy," the engineering, ecological, and quality specifications will be determined. Basic trends in the proposed exploratory research include development of flexible, automated, resource-saving, and low- or waste-free engineering processes, preparation of new polymers, and development of stronger and longer-lasting heat-, fire-, and chemically-resistant materials, membranes, and bio-engineering processes.

12765

UDC 678.743.22.033:536

Effect of Finely Dispersed Fillers on Thermal Conductivity of PVC-Composites

18410470b Moscow PLASTICHESKIYE MASSY in Russian No 7, Jul 87 pp 56-58

[Article by B.P. Demyanyuk and B.S. Kolypayev]

[Abstract] The problem of substituting costly construction and other materials with cheaper polymers is currently being resolved, in part, by developing binary filler composites. However, components of the composite tend to react with the filler in a selective way, where adsorption of one of the components to the surface of the polymer is possible. This results in alteration in the composition of the polymer both at the interface and in the bulk. In the present work, a study was made of the effects of metal powders (Cu, Fe, and W) on the thermal conductivity of Grade S-65 polyvinyl chloride (molecular weight 140,000) and in combination with Grade PSH polyvinyl butyral (PVB) and Grade BZh-1 phenolformaldehyde resin, used as fillers. Samples were prepared by hot pressing at 393-403 K and 10-100 MPa pressure. The coefficient of thermal conductivity was determined with an adiabatic calorimeter with a relative error not exceeding 4-6%. Density and volume characteristics were determined by hydrostatic weighing. Results show that thermal conductivity varies linearly with temperature within the glassification zone and then drops in the zone where transition to high elasticity occurs. Inflection points were observed at glassification temperatures for the composites, while the angle of inclination varied with both the content and nature of the filler. Increasing the Cu content from 0.5 to 6.1% by volume in PVC containing BZh-1 resulted in a drop from 0.0004 to 0.0001 K^{-1} in thermal conductivity. PVC-composites containing 5.5, 11.5, 23.0, and 34.0% by volume of BZh-1 and 1.6% by volume of Cu had thermal conductivity coefficients of 0.003, 0.002, 0.001, and 0.001, respectively. The thermal conductivity of PVC-composites containing

PVB varied similarly with temperature. With the same amount of PVB or BZh-1 and equal quantities of metal, the thermal conductivity coefficient decreased with temperature in the order Fe Cu W. Figures 2; table 1; references 6: Russian.

12765

Gospriyemka: Lessons in Quality of Rubber Products

18410470c Moscow KAUCHUK I REZINA in Russian No 7, Jul 87 pp 2-4

[Article by Yu.V. Smirnov, USSR Gosstandart]

[Abstract] In the present day large scale re-structuring of the national economy, the problem of quality takes on priority significance because product quality reflects achievement of the Soviet people in socialist production and social problems. One way to increase product quality has been to introduce State Acceptance of Products (Gospriyemka) at enterprises, including those which produce tires and industrial rubber products. The organs of this organization are called upon to control the entire complex of operations, conducted by an enterprise, needed to provide high quality products. Personnel in this organization observe strict control over the requirements of standard-technical, design, and engineering documentation and participate in work of the State Commission on Product Certification. The chief of the State Acceptance organ is delegated with the authority of Chief State Inspector on Supervision of Standards and Measurements at an enterprise, and he may terminate acceptance of products which do not comply with documented requirements. Gospriyemka also checks input control by avoiding the use of raw materials and goods which fail to meet documented requirements. When low quality goods arrive at a plant, the organs of Gospriyemka intervene with the supplier through his Gospriyemka or through the territorial organ of the State Supervisor for USSR Gosstandart if one does not exist. During the initial formative stages, Gospriyemka organs face such questions as: by operating "behind the back" of OTK (Division of Technical Control), would not Gospriyemka personnel duplicate the efforts of plant personnel? OTK and Gospriyemka personnel complement each other without duplication. Since technical control is an inseparable function of an engineering process, OTK is called upon to observe all steps of a process. Highly qualified Gospriyemka specialists, numbering several times fewer than OTK controllers, selectively check what has already been accepted by the latter. Almost 90% of Gospriyemka personnel are former specialists of the same enterprises where they now conduct quality control. Having full knowledge of the production process, they can detect defects together with enterprise specialists and take steps to eliminate them. One serious problem is the production of heavy duty steel-belted truck tires for ZIL and KamAZ. Unless enterprises increase their assortment of tires to include these, then during the next one or two years, many plants operating under self-financing will find themselves in difficult circumstances.

12765

Relationship of Electrical Conductivity of Metal-Filled Polymer Adhesives to Properties of their Components

18410055a Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 296, No 3, Sep 87 (manuscript received 13 Apr 87) pp 643-645

[Article by G.V. Kozlov, Institute of Physical Chemistry, USSR Academy of Sciences, Moscow]

[Abstract] Studies were performed of the variation in conductivity of metal-filled polymer adhesives as a function of temperature during curing, revealing a correlation between the shrinkage of the adhesive and its conductivity. The maximum increase in conductivity was observed when the polymer matrix was in a state of viscous flow. At temperatures above the gel- formation temperature, the increase in conductivity was slow. If the glass point was reached, there was a jump in conductivity, apparently resulting from further curing of the polymer matrix and stress relaxation. Equations were presented, allowing for estimation of the contact forces, which compress filler particles in such adhesives, are responsible for conductivity, and are caused by shrinkage of the binder. References 11: Russian.

6508

Specifics of Self-Organization in Formation of Mutually Penetrating Polymer Networks

18410055b Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 296, No 3, Sep 87 (manuscript received 5 May 87) pp 646-648

[Article by Yu.S. Lipatov, academician, Ukrainian SSR Academy of Sciences, Institute of the Chemistry of High-Molecular-Weight Compounds, Ukrainian SSR Academy of Sciences, Kiev]

[Abstract] Based on experimental data produced in a previous work, the authors present for the first time, in qualitative form, the general conditions for self-organization during the formation of mutually penetrating polymer networks under thermodynamic nonequilibrium conditions and note the basic factors influencing the structure of hybrid matrices. The general conditions for self organization are determined by: a) the relationship of the rates of chemical reactions in forming the component networks and b) processes of the sol-gel transition and phase separation, which occur in varying ways, depending on the sequence of the transitions. The networks are formed by three regions of incomplete phase separation, each of which has its own characteristic dimensions and composition and is an independent

network with molecular mixing of components, resulting from their forced combination. All three regions are thus nonequilibrium dissipative structures. The structure of the networks is determined by the close interrelationship of thermodynamic and kinetic conditions. References 15: 13 Russian, 2 Western.

6508

MNTK "Svetovod" Studies New Materials for Fiber Optics

18410055c Moscow KHIMIYA I ZHIZN in Russian No 9, Sep 87 pp 27-30

[Article by O. Olgin, special correspondent]

[Abstract] The Interbranch Scientific-Technical Complex (MNTK) "Svetovod" (fiber optics) was recently formed. The Yaroslavl Polytechnic Institute has now created a polymer coating for optical fibers, based on an original technology which uses domestic raw materials. It is available at five rubles rather than $100 per kilogram. The "Lakokraska" Production Association in Yaroslavl has voluntarily begun studying the manufacture of an epoxy arylate compound needed to manufacture the coatings, rather than wait for orders from the State to begin research. The Association believes the same polymer coating used for optical fibers will be useful as a furniture coating.

6508

All-Union Workshop-Seminar on Polymers, Composite Materials

18410097a Baku BAKINSKIY RABOCHIY in Russian 13 Oct 87 p 2

[Text] Polymers which can replace metals and other costly materials are being used more and more intensively in many branches of the economy and in Soviet programs for the peaceful exploration of space. Questions of developing and improving these substances are the focus of attention of young scientists and specialists from many cities of the country who are taking part in the first All-Union Workshop-Symposium on the Problem "Polymers and Composite Materials." It began its work on 12 October at the International Youth Center "Gyandzhlik."

The workshop was organized by the Central Committee of the All-Union Lenin Communist Youth League, the Presidium of the USSR Academy of Sciences, the Central Board of the All-Union Chemistry Society imeni Mendeleyev (VKhO), the Azerbaydzhan Academy of Sciences' Institute of Petrochemical Processes, and the Azerbaydzhan board of VKhO.

FTD/SNAP

/06091

Nonflammable Compounds for Nuclear Power Station Cables

18410097b Moscow MOSKOVSKAYA PRAVDA in Russian 13 Oct 87 p 2

[Text] A series of nonflammable cables for nuclear power stations has been developed and introduced into production at the All-Union Scientific Research Institute of the Cable Industry.

In collaboration with chemists, a formula and process were developed, and plastic polyvinylchloride compounds with lowered combustibility were introduced into industrial production. This material is being produced in a volume which fully meets the needs of all of the country's nuclear power stations. The quality of these compounds matches that of the best foreign counterparts, which makes it possible to discontinue importing costly materials.

[Two photographs are given showing V. Logunov, head of the institute's polymer research laboratory, N. Soboleva, head of the laboratory of polymer processing technology, and a laboratory worker preparing specimens of noncombustible materials for testing.]

FTD/SNAP

/06091

International Conference on Electronics of Organic Materials

18410133a Tashkent PRAVDA VOSTOKA in Russian 19 Nov 87 p 3

[Text] Problems of developing biocomputers on the basis of ultraminiature organic electronic components will be discussed by the participants in an international conference on electronics of organic materials, "Elorma-87," which opened in Tashkent on 17 November. Taking part in this conference are scientists and specialists from 18 countries, including the United States, Japan, Great Britain, France, Belgium, Switzerland, and Yugoslavia.

Polymers may become the basis of future electronic instruments with components no larger than large molecules, i.e., thousands of times smaller than present-day microcircuits. Specialists are exchanging new ideas and information on the latest achievements in fields of this promising science and outlining paths for further research.

FTD/SNAP

/06091

Polymers as Conductors
18410133b Moscow SECOND RADIO PROGRAM MAYAK in Russian 2330 GMT 23 Nov 87

[Text] "An international conference on problems of using organic materials in electronics and instrument-making has taken place in Tashkent." Anvar Zakidov, one of the leading scientists in Uzbekistan, talks to our correspondent about the newest materials of the 20th century being created by Soviet scientists and prospects for their use. Zakidov says we are all familiar with use of inorganic materials in electronics, but, he notes, organic materials for electronics were created at the beginning of the 1980's through scientists' efforts; for example, polymers, which can act as metals, superconductors, etc. He says that Uzbek scientists were among the first to get involved in this direction of work. In 1984, he says, work on organic materials was started at the Nuclear Institute; unique materials were created for the first time, i.e., polyacetylene. In literally the last 2-week period, electric conductivity has been obtained in polyacetylene which is better than copper. He says this means that in the near future, it will be possible to create conductors not out of copper or aluminum, but out of polymers which are virtually no different from ordinary plastics used in insulation. Thin films have been obtained—polyphenylene polyaniline and polyaniline. On the basis of the latter, the first photo-converters have been created. They will make it possible to directly convert the energy of sunlight into electrical energy. He points out that the joint efforts of chemists, physicists, etc., go into such work.

/06091

Delay in Introducing Nuclear Filters for Medicine, Microelectronics
18410180b Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 19 Dec 87 p 2

[Article by correspondent A. Kurbatov]

[Excerpt] A nuclear filter can be produced in a matter of minutes, using a special unit. I saw this done in the nuclear-reactions laboratory at the Joint Institute for Nuclear Research in Dubna, a suburb of Moscow. The laboratory's unit is compact and strikingly simple. A film made of lavsan plastic is wound from one drum onto another. Between the drums are two zones. In one of them, heavy ions which are invisible to the eye pierce the film and transform it literally into a sieve. The surface on which the heavy ions have left their marks undergoes physicochemical treatment in the other zone. The holes in the nuclear filters can be varied from 0.01 micron to several microns in diameter, as desired. The number of these pores is fantastic—up to several tens of billions per square centimeter!

Another important feature of nuclear filters is that sediments are very easy to remove from them.

V. Mchedlishvili, head of a laboratory of the USSR Academy of Sciences' Institute of Crystallography, said: "A nuclear filter cap was enthusiastically received both in the USSR Ministry of Health's committee on new medical technology and by an expert commission on instruments, apparatus, and equipment employed in general surgery. Professor G. Lukomskiy is the head of this commission."

Would production of nuclear filter caps for purifying medicinal solutions really ruin our economy? Not at all. A single tiny cap for a syringe costs only 8 kopeks! As for the cost of nuclear filters in general, it is appropriate to mention that one square meter of filter costs 40 rubles.

The main parameters of our filters are better than those of American ones. After taking the lead in invention, however, we have fallen hopelessly into arrears in introduction, which is a most disturbing fact.

Nuclear filters are widely employed in microelectronics. In the semiconductor industry, it is now impossible even to "breathe" without such filters. In production of complex integrated circuits, where dozens of components occupy an area of a few square millimeters, spoilage results if the tiniest bit of foreign matter (a speck of dust or a bacterium) gets into a product. It has been established that use of nuclear filers for air purification increases output of finished products of excellent quality by several times.

In only half a year, scientists of the USSR Academy of Sciences' Institute of Crystallography and virologists jointly succeeded in developing a process for isolating an AIDS virus from a culture medium diluted with proteins. This was accomplished with the aid of a nuclear filter. A purified concentrate of the virus was used in biotechnology for developing a diagnostic preparation.

/06662

Paper Association Develops Filter Medium for Membranes, Heating Panels
18410180a Leningrad LENINGRADSKAYA PRAVDA in Russian 15 Dec 87 p 2

[Article by V. Bukharov]

[Excerpt] A base, i.e., a filter medium, for membrane technology has been obtained, for the first time in Soviet practice, at the All-Union Research and Production Association of the Pulp-and-Paper Industry in Leningrad.

This association is a member-organization of the inter-branch scientific-technical complex [MNTK] "Membranes", which was created for the purpose of advancing this important technology in our country.

It must be mentioned that this assignment did not come as a surprise to employees of the Association's synthetic-papers sector. Its personnel pioneered introduction of Soviet-made synthetic paper several years ago, when there were only four associates in the sector in addition to its director, L.N. Yanchenko.

Paper with a lavsan base that is employed as an electrical insulating material is now in tremendous demand in the country's electric machine building industry. The filter medium for membranes was based on a material of precisely this kind.

Bureaucratic barriers remain a serious obstacle even in production of the filter medium, which is needed so badly by industry. The Ministry of the Chemical Industry, for example, still is unable to introduce raw materials for the lavsan base into production, due to the small volume of orders. No enterprise has been found as yet which would organize industrial production of one more innovation.

Ye.I. Vasilyeva, the present head of the sector, showed me an ordinary-looking panel made of plastic and explained: "This is essentially an electric heating device. Synthetic paper embedded in it functions as a heater. Panels like it can be used to finish walls, ceilings and floors of outpost dwellings, trade stands, livestock-raising sections, etc. This would be economical and convenient! Unfortunately, only test prototypes of the panels exist at present."

/06662

UDC 541.15.621.039.714.852.538

Improving Emulsion Separation Processes for Nuclear Fuel Industry

18410487a Leningrad RADIOKHIMIYA in Russian Vol 29, No 3, May-Jun 87 (manuscript received 25 Feb 86) pp 318-325

[Article by D.M. Gurevich]

[Abstract] It is impossible to conduct an extraction process in the nuclear fuel cycle without contaminating aqueous solutions with emulsified organic extractants and solvents. The emulsion occurs partly as a result of mechanical wear during mixing of extraction system components. When the volumetric ratio of two mixed phases is close to unity, the simultaneous formation of both direct and reverse emulsions is apparently enhanced. It has also been reported that when handling nuclear fuel, it is impossible to avoid forming stable emulsions at the phase interface due to stabilization of surfactant products of extractant and solvent radiolysis, as well as colloids, unless the solutions are treated properly. Contamination of raffinates and re-extracts with emulsified organic compounds makes it difficult to use them for subsequent treatment and lowers the efficiency of the extraction process and the quality of production. The high toxicity of these substances causes additional industrial pollution of the biosphere when radiochemically pure wastes are dumped into the environment. This makes it imperative to conduct research on developing effective methods for de-emulsification which satisfy the specific requirements of nuclear fuel technology. In the present work, a "flotation" model of a magnetic emulsion separation process, derived on the basis of previously published data, is proposed. According to this process, particles of a ferromagnetic powder interact with emulsion droplets chiefly as a result of flotation. On the basis of this model, a method is proposed for calculating the optimum phase ratios and evaluating the feasibility of an effective magnetic emulsion separation process, based on a comparison of the fundamental forces acting on a particle. The calculated results agree with experimental data with respect to a decrease in the process' efficiency in the presence of surfactants. Figures 3; tables 2; references 10: 5 Russian, 5 Western.

12765

UDC 543.51

Mass-Spectrometric Analysis of Nanogram Quantities of Stable Ruthenium in Spent Nuclear Fuel

18410487b Leningrad RADIOKHIMIYA in Russian Vol 29, No 3, May-Jun 87 (manuscript received 18 Mar 86) pp 397-401

[Article by V.M. Andreyev-Savelyev, B.N. Belyayev, L.S. Bulyanitsa, A.V. Lovtsyus, T.P. Mararova, A.V. Stepanov, and B.I. Tarler]

[Abstract] The solution to certain problems in nuclear fuel research requires knowledge of that fraction of total fission which consists of individual nuclei. This is especially true in calculating the effective yields of monitors when determining the burn-out of spent fuel from fission products. Currently, only a semi-empirical method based on heavy atoms is available for determining individual heavy nuclei. Each addend in an aggregate of fission products, i.e., heavy neutrons resulting from U-235, Pu-239, and Pu-241, and fast neutrons resulting from U-238, is computed by utilizing a nuclear-physical constant which introduces a high error, especially for Pu-241 and U-238, characterized by a low (to 10%) contribution to the total fission. Methods for solving this problem have been developed for the case where it is possible to neglect the Pu-241 and U-238 fractions. The basis for these methods lies in a comparison of the contents of two splinter nuclides, one of which has essentially the same and the other greatly differing yields during U-235 and Pu-239 fission. Ruthenium isotopes result from this type of fission, especially Ru-106, whose yield in the fission of Pu-239 is 12 times greater than in U-235 fission. Comparison of several variants indicates that the most simple is the determination of burn-out components by the Ru-106/Cs-137 ratio, since both nuclides are readily identified in the gamma-spectrum of an unseparated mixture of fission products. In the present work, the deposition of nanogram quantities of ruthenium, extracted from solutions of spent nuclear fuel, directly onto the rhenium evaporator of a mass spectrometer's ion source has been demonstrated, using a specially designed, detachable electrolyzer. At low levels of ruthenium content, mass spectrometry has been experimentally shown to be capable of measuring the 101 and 104 isotope ratios with sufficient accuracy to serve as a reference for methods of evaluating burn-out totals for spent nuclear fuel. Figures 3; references 10: 6 Russian, 4 Western.

12765

UDC 681.332+546.799.8

Equipment and Method for Measuring Uniformity of Nuclide Distribution in Extended Sources

18410487c Leningrad RADIOKHIMIYA in Russian Vol 29, No 3, May-Jun 87 (manuscript received 1 Dec 83) pp 409-411

[Article by A.A. Bondarev, V.D. Gavrilov, V.M. Radchenko, and V.L. Berkutov]

[Abstract] The distribution of a radioactive element along the length of a source is one its basic characteristics which may be controlled by gamma- scanning. An increase in developing and using new sources and operation experience with gamma-scanning sources has made it imperative to improve the sensitivity of gamma-radiation recorders and the efficiency of scanning sources. In the present work, a gamma-scanning device is

developed for controlling the distribution of a radioactive element in an extended source, based on californium-252, curium-244, and americium-241. The gamma-scanning device consists of a scanning device, a gamma-quantum detector, an analog track measuring device, devices for collecting, recording, processing, and outputting information, and a control panel. Test results for an extended source are presented as well as recommendations for improvements. Figures 4; references 2: Russian.

12765

Influence of Irrigation Water Mineralization on Uranium-238 Level in Harvested Crops

18410056a Moscow AGROKHIMIYA in Russian No 8, Aug 87 (manuscript received 2 Sep 86) pp 81-84

[Article by V.S. Shevchenko, G.S. Ishchenko, I.D. Dergunov, and T.F. Afanasyeva, Central Asian Scientific Research Institute of Phytopathology, Tashkent]

[Abstract] An agricultural experiment was used to study the influence of irrigation water quality on uptake of U-238 by certain crops in typical serozem soil containing 43-45% physical clay, 8.33% carbonate, and a non-saline content of: Ca 9.23, Mg 0.99, K 0.54, and Na 0.17 mg-eq/100 g. Studies were performed on corn and cotton with U-238 introduced before planting and with irrigation water levels kept at 5, 100, and 400 mg/kg of soil during cultivation. Both fresh and mineralized water containing Na_2Co_3, $CaCl_2$, NaCl, $MgCl_2$, and Na_2SO_4 in the ratio 1:1:2:1:2 for a total of 2 g/l were used for irrigation. The mineralized water was found to increase the toxic effect of uranium on the plants, increasing accumulation of uranium in cotton by 30 to 70% and in corn by 50%. Figures 2, references 2: Russian.

6508

Separation of H_2-T_2, HD-T_2, D_2-T_2, HT-T_2, DT-T_2 Mixtures on NaX and NaA Zeolites

18410056b Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 61, No 8, Aug 87 (manuscript received 21 Jan 87) pp 2271-2274

[Article by A.S. Polevoy, A.I. Durneva and A.O. Azizov, Moscow Institute of Chemical Engineering imeni D.I. Mendeleyev]

[Abstract] The separation coefficients of mixtures of hydrogen, deuterium, and tritium on NaX and NaA zeolites were experimentally determined by one-time isotope balancing of hydrogen in the gas and solid phases as hydrogen circulated through a saturated layer of sorbent. The separation coefficients of tritium-containing isotope mixtures of molecular hydrogen on NaX and NaA zeolites produced in this work can be used to plan separating apparatus for continuous two-phase processes of separating tritium from its isotope mixtures in a gas-solid system. The results obtained are compared with calculated results, based on sorption isotherms of the individual components. References 18: 17 Russian, 1 Eastern European.

6508

UDC 535.37:546.799.6

Self-Luminescence of Americium in $Cs_2NaLa(Am)Cl_6$ Crystal

18410092 Moscow DOKLADY AKADEMII NAUK SSSR in Russian (manuscript received 3 Feb 87) Vol 296No 6,Oct 87pp 1420-1423

[Article by G.P. Chudovskaya, Yu.A. Barbanel and Yu.I. Gavrish, Radium Institute imeni V.G. Khlopin, Leningrad]

[Text] Self-luminescence spectra of Americium were presented for the first time, and features of photoluminescence and radioluminescence, caused by specific characteristics of the matrix studied, were discussed. Study of the kinetics of luminescence of this crystal showed that it glows without laser excitation because it is self-luminescent. Luminescence spectra were recorded in the 400-1000 nm range. Photoluminescence was excited by a nitrogen pulsed laser. The self-luminescence spectrum of Am(III) in the 800-900 nm range at room temperature was not evident because of low intensity (according to the photon count). It was concluded that self-luminescence of Americium is a specific form of radioluminescence with the following features: 1) generation of natural optical radiation by an alpha-nuclide with a rather long (7369 years) half-life and corresponding low specific activity is much less than that in the case of ^{244}Cm in comparable quantities; 2) high characteristic nature of the radiation; 3) permanence of the radiation; and 4) combination of the self-luminescence phenomenon with prolonged (measured in hours) relaxation after photoexcitation. Figure 1; references 11: 4 Russian; 7 Western.

02791

Study of Separation Processes of Transplutonium Elements by Emulsion Membrane Extraction

18410147a Leningrad RADIOKHIMIYA in Russian Vol 29, No 5, Sep-Oct 87 (manuscript received 19 Apr 86) pp 607-611

[Article by A.P. Novikov and B.F. Myasoyedov]

[Abstract] Membrane extraction is a promising method for the separation of substances which has certain advantages over liquid extraction, its nearest analogue. Most of the research done on this process has been directed towards determining its engineering-economic advantages in the hydro-metallurgy of non-ferrous metals. However, membrane extraction may also be applied to the solution of problems in the effective leaching of

radioactive wastes and the separation of actinide elements which have similar properties. The purpose of the present work was to study the processes of separation of transplutonium elements during extraction with liquid emulsions of the water-in-oil type. The emulsion was prepared by stirring at 2000 rpm the organic and reextraction phases taken at a 1:1.5 ratio by volume with 4% by weight of span-80 as emulsifier and di-2-ethylhexylphosphoric acid as carrier. Kinetics of the extraction process were studied, and conditions for the effective leaching and separation of trivalent americium, curium, and californium from solutions of diethylenetriamine penta-acetic acid were determined. Figure 1; tables 2; references 10: 3 Russian, 7 Western.

12765

Separation and Recovery of Transplutonium Elements from Other Actinides on Ionites from Aqueous and Aqueous-Ethanol Solutions of Sulfuric Acid

18410147b Leningrad RADIOKHIMIYA in Russian Vol 29, No 5, Sep-Oct 87 (manuscript received 8 Jul 86) pp 629-634

[Article by L.I. Guseva, G.S. Tikhomirova and V.V. Stepushkina]

[Abstract] The development of methods for concentrating and isolating transplutonium elements from sulfuric acid solutions is a very urgent problem because sulfuric acid is widely used both in technology and in analysis. In nuclear technology, sulfuric acid is used for wet burning of wastes, containing such materials as paper, polyethylene, protective gloves, etc. Sulfuric acid is used to detect and leach out minerals in ores during the determination of actinides and rare earth elements in the environment. Transplutonium elements are separated electrolytically from sulfuric acid during the preparation of thin layer targets for radiometric measurements. Recently, much work has been done on the study of oxidation-reduction reactions in developing extraction methods for separating transplutonium elements in sulfuric acid solutions. The possibility of employing ionites for the separation or recovery of transplutonium elements from other elements in sulfuric acid solutions has not been studied, nor has the behavior of transplutonium elements on ionites in mixed aqueous-organic solutions of sulfuric acid. In the present work, a study was made of the behavior of Am, Cm, Bk, Cf, Es, and other actinides, as well as Zr, on anionites and cationites in aqueous and aqueous-alcohol solutions of sulfuric acid as a function of the concentration of various components of the solution. It was observed that the presence of alcohol in sulfuric acid solutions results in an increase in the distribution coefficients of both cationites and anionites. It was also demonstrated that ionites may be used to concentrate and recover transplutonium elements from U, Np, Pu, Zr, and other elements to form stable complexes with sulfate ions over a wide range of sulfuric acid concentrations. Figures 6; tables 2; references 8: 4 Russian, 4 Western.

12765

Study of Uranium Sorption from Carbonate-Containing Solutions with Inorganic Sorbents. Part 9.: Sorption Kinetics of Uranium on Fibers Filled with Highly Dispersed Sorbents

18410147c Leningrad RADIOKHIMIYA in Russian Vol 29, No 5, Sep-Oct 87 (manuscript received 19 Apr 86, at the final editor 9 Apr 87) pp 638-642

[Article by M.N. Mikheyeva, B.F. Myasoyedov, Yu.P. Novikov, V.M. Komarevskiy, M.S. Mezhirov, R.K. Idiatulov, and A.N. Fedorova]

[Abstract] Much attention has been devoted to the development of effective means of extracting uranium from sea water with pelletized inorganic sorbents. However, one of the shortcomings of these sorbents lies in the low specific contact surface between the sorbent and the solution, which limits the sorption rate. Using finely divided sorbents with a large contact surface is also limited, due to the slow filtration rate of the solution through the sorbent bed and difficulties in phase separation. The use of inert carriers such as muslin, pumice, or fiberglass also fails, due to the low adhesion strength of the sorbent particles to the carrier surface. It thus appeared promising to employ microcomponents of polymeric fibers filled with finely divided inorganic sorbent. During synthesis, the finely dispersed sorbent particles are partially enveloped with polymer filaments and become firmly embedded in the fiber. The large cell structure of the fiber facilitates free access of the solution to sorbent particles. In the present work, a study was made of uranium sorption from carbonate-containing solutions of the sea water type, using polyacrylonitrile fiber, containing 50-80% finely dispersed (1-3 microns) Thermoxide-5, a titanium oxide sorbent. Sorption kinetics were studied at 20-65 degrees C and pH 7.85. A formula was derived to correlate the general sorption rate constant of uranium with its temperature and concentration in the initial solution. The rate constant is independent of the degree of filling of the fiber with sorbent within the range studied. Figures 3; tables 2; references 6: 4 Russian, 2 Western.

12765

Using Steam Radiolysis under alpha-Radiation and Fission Fragments for Producing Hydrogen

18410147d Leningrad RADIOKHIMIYA in Russian Vol 29, No 5, Sep-Oct 87 (manuscript received 8 Feb 85, at the final editor 22 Jun 87) pp 675-681

[Article by B.S. Kalinichenko, V.G. Kulazhko, N.A. Kalashnikov, I.K. Shvetsov and V.N. Serebryakov]

[Abstract] Much research is currently being conducted on the production of hydrogen and oxygen from water by electrolysis, photolysis, thermochemical methods, etc.

Along with these traditional methods, more and more attention is being given to water radiolysis. According to preliminary calculations, water radiolysis can have practical significance for problems in nuclear-hydrogen power engineering, as well as in habitation of remote installations. The key factor in studying the feasibility of using radiolytic decomposition of water lies in achieving the maximum possible efficiency of the process, i.e., increasing the yield of molecular products of radiolysis. In the present work, a study was made of the rate of formation of gaseous products in the radiolysis of water and steam under alpha-radiation from curium-244, plutonium-238, and fission products from californium-252. The yields of molecular products were determined as 1.05 molecules per 100 eV for water and 5.8 plus or minus 0.3 eV for steam. Irradiation of steam with californium-252 fission products resulted in a hydrogen yield of 8.4 molecules per 100 eV. Figures 8; references 8: 6 Russian, 2 Western.

12765

Transfer of Hydrogen Isotopes through Bipolar Hydrogen-Permeable Electrode

18410147e Leningrad RADIOKHIMIYA in Russian Vol 29, No 5, Sep-Oct 87 (manuscript received 25 Aug 86, at the final editor 13 Apr 87) pp 686-688 sb

[Article by L.N. Moskvin and V.S. Gurskiy]

[Abstract] Bipolar electrodes made of palladium and its alloys attracted attention as a convenient system for realizing a multi-stage electrolysis cascade for separating hydrogen isotopes. Their advantage over a conventional electrolysis cascade lies in the lack of gaseous hydrogen separation at intermediate electrolysis stages. Taking into account the low discharge overvoltage and hydrogen ionization values on palladium, one can further expect a significant drop in energy consumption. This has been established in studying the mechanism of hydrogen transfer through a bipolar hydrogen-permeaole electrode. In the present work, the unit coefficients of protium and tritium separation during transfer through a bipolar Pd-Ag-20 electrode in KOH solutions at 50 degrees C were determined. The values are 11.8 plus or minus 0.6 for 10 moles/liter of KOH and 13.4 plus or minus 1.9 for 2 moles/liter of KOH at 0.1 A/cm^2 current density. They agree well with estimates on multi-stage hydrogen isotope separation over bipolar hydrogen-permeable electrodes. Figure 1; references 6: 3 Russian, 3 Western.

12765

USSR State Prize for Studies of Nonaqueous Solutions

18410134 Leningrad LENINGRADSKAYA PRAVDA in Russian 21 Nov 87 p 2

[Text] The telephone has been ringing more often than usual lately at the Chair of Physical Chemistry at Leningrad State University imeni Zhdanov. Friends, colleagues, and pupils are congratulating Doctor of Chemical Sciences and Professor A.G. Morachevskiy, head of a scientific research laboratory, and Doctor of Chemical Sciences and Professor N.A. Smirnova on being awarded the 1987 USSR State Prize.

Work of these two scientists is a continuation of a classical direction in the School of Chemistry at the university. In collaboration with specialists of a number of the country's institutes, they have devoted more than 20 years to theoretical and experimental research, involving study of physicochemical properties of nonaqueous solutions. Results of this basic work have found application immediately in the chemical, petrochemical, textile, and electrical-equipment industries. The economic benefit from developments based on research of these scientists is already more than 10 million rubles.

[A photograph is given showing Smirnova and Morachevskiy in a laboratory.]

FTD/SNAP

/06091

Foreign Ministry Statement Protests U.S. Chemical Weapons Production

18410182 Moscow KRASNAYA ZVEZDA in Russian 27 Dec 87 p 3

[Excerpt] On December 16, 1987, the US began production of new-generation chemical weapons—binary ones. A step toward a new round of the chemical weapons race has thus been taken with no provocation whatsoever.

American representatives usually cite the chemical warfare threat allegedly originating in the Soviet Union when attempting to justify the start of binary-weapons production in the eyes of world opinion. Utterly fantastic "data" on reserves of chemical weapons in the USSR are cited in this connection. It is claimed that such reserves in the USSR consist of from 250,000 to 700,000 tons of chemical warfare agents and that the USSR is many times superior to the US in this field.

This deception must be put to an end. The USSR Ministry of Foreign Affairs is authorized to announce that chemical-weapons reserves in the USSR do not exceed 50,000 tons in terms of toxic agents. According to estimates made by Soviet experts, this figure corresponds approximately to the chemical weapons reserves of the United States. Moreover, all Soviet chemical weapons are on the territory of the USSR.

The Soviet Union has halted production of chemical weapons, has never employed such weapons, has not placed them in the hands of others, and has not deployed them beyond its borders. Work on creating capacities for destroying our entire arsenal of chemical weapons is being pursued vigorously in our country, in preparation for conclusion of an [international] convention.

The Soviet Union condemns this action of the US and thinks that it creates a new situation in the field of chemical weapons which may necessitate adoption of appropriate measures.

/06662

"Task Force" Lands in Shikhany

18410099 Moscow NEW TIMES in English No 41, 19 Oct 87 pp 11-12

[Article by Dmitry Pogorzhelsky, special correspondent]

[Text] A "task force," consisting of four generals, 17 senior officers, as well as experts, diplomats, and journalists from 44 countries, 110 people in all, arrived near a secret military installation in the Saratov Region on 3 October.

How does a Soviet Major General in charge of a once obscure secret military installation feel about so many foreigners being "thrust" upon him?

Robert Fedorovich Razuvanov found it hard to conceal his emotions. Not that he resented the "intrusion." His responsible mission was to show the participants in the Geneva Disarmament Conference standard models of Soviet chemical weaponry and to demonstrate methods of destroying them.

The Road to the Proving Ground

We set out for the proving ground from Barai-Baranovka military airfield along a concrete-surfaced road—a white ribbon winding its way across a vast tract of the Volga steppe.

In my opinion, however, the road to Shikhany is a temporal rather than a geographical notion—it had its beginnings in April 1985, with January and February 1986 as milestones in our progress along it. Guided by new political thinking and glasnost, we have achieved unprecedented standards of openness, as evidenced by the trip to Shikhany.

Indeed, the USSR had not for many years made it clear whether it had chemical weapons at all, although it did conduct bilateral talks with the United States and is party to multilateral talks in Geneva on the banning and elimination of these means of mass destruction.

May I remind the reader that the USSR was among the first countries to sign, back in 1925, the Geneva protocol banning the use of chemical and bacteriological weapons. The use of these weapons, I repeat, not their development and stockpiling. Since then, the Soviet Union has been working persistently for the banning and elimination of these barbarous weapons of mass annihilation under effective international control and has come up with several bold initiatives and proposals towards that end. Unfortunately, our partners, the U.S. in particular, rejected them. Chemical weapons, which have become a component of the "deterrence" equation, have been and still remain in the Soviet Army's arsenal. They have been developed and stockpiled for defense purposes only. So was it really necessary to keep silent for so long? After all, the USSR had stopped making many kinds of chemical weapons long before the United States did. But these facts have been disclosed only today.

I don't think that our silence or our resorting to evasion and ambiguity when it came to the subject of Soviet chemical weapons added weight to Soviet initiatives in Geneva or to our partners' trust in the USSR.

The ice was broken in April 1987, when the USSR announced that it had stopped production of chemical weapons and was building a plant for their destruction. On 6 August, the Soviet delegation said in Geneva that, eager to have a convention signed at an early date, it would insist on making on-the-spot inspections when requested and denying any state the right not to abide by it. (Incidentally,the British FINANCIAL TIMES described these inspections as a beast which hardly any government would like to let out of its cage). On the same day of 6 August, the Soviet Union invited participants and observers at the Geneva talks to a chemical weapons proving ground. Moscow made this unprecedented move with the sole purpose of making the convention to ban and destroy chemical weapons a reality as soon as possible.

That is how we found ourselves in Shikhany.

The chemical weapons on display there certainly meant much more to experts than to us journalists. And it was mostly for the experts' benefit that our officers described the weapons in detail for a good 2 hours and explained the effects of the toxic agents each weapon was "stuffed" with.

A Demonstration

Frankly, the 19 standard models lined up on a dazzling white podium—hand grenades, artillery shells, rocket-assisted projectiles, aircraft bombs, tactical missile warheads, each battleship—gray and bearing marking bands—did not look all that impressive or awesome. It was some time before I realized that they disgusted me. Any weapons do it with deadlier efficiency than other kinds.

Foreign guests watching the complicated process of chemical weapon destruction.

The convention must be signed if the world is even to get rid of chemical weapons.

The second day of the guests' stay in Shikhany was given over to demonstrations of techniques for destroying chemical weapons.

A mobile complex was deployed under a huge awning right on the proving ground. What happened there did not seem quite real.

Men wearing silvery protective suits and black gas-masks appeared on the scene and set to work. One checked a 250-kilo bomb for leaks; another got behind the wheel of a fork-lift truck, jacked the bomb up smartly, and placed it in a special unit; and a team of three opened the bomb, collected a sample of its stuffing, and put it on an ordinary office desk between two hutches, each containing a live rabbit.

The bomb was encased in the unit, drilled, and emptied of its toxic agent, which was subsequently transferred to a neutralizer where the most important process—toxic agent decomposition—took place.

Before that, one of the rabbits was injected with a syringe full of liquid extracted from the bomb and put back into its hutch at once. The poor animal twitched convulsively for a second or two and then dropped dead. The hutch was covered with a piece of white cloth.

Although not a sight for the squeamish, the demonstration was necessary to make certain that the bomb was charged with sarin nerve gas.

Two hours later, another sample was taken—from the neutralizer this time—and "pumped" into the other rabbit without doing it any harm. The process of sarin decomposition had been completed. The warmed-up liquid, which had just been a deadly toxic agent, was piped into a special tank truck, carried to a furnace a little way off, and burned down at a temperature of over a thousand degrees C. Clouds of black but virtually innocuous smoke started belching from its chimney, announcing that the world was minus one chemical bomb.

Mine has certainly been only a sketchy description of how a toxic agent is neuturalized; in fact, the process is fairly complex and costly. But let us leave the particulars to the experts who followed the entire process with keen interest, finalizing formulas, doses, and other essential data.

What matters most is that this process was watched at the Soviet military proving ground by representatives of 44 states.

What Next?

Two days of reports, questions, briefings, and exchanges of opinion went by.

I was naturally interested in what the experts had to say.

Ambassador Rolf Ekeus, Sweden's representative in Geneva, is also chairman of the Ad Hoc Committee on Chemical Weapons at the Geneva Conference:

"Id like to compliment you on this demonstration. It has been most impressive and surpassed my boldest expectations. I'm sure all we've seen here will have a positive effect on the progress of our talks in Geneva because it has established a higher level of confidence."

"Mr Ekeus, you said last winter that you hoped to be the last chairman of the Ad Hoc Committee on Chemical Weapons because the talks on signing the convention had reached the final stage...."

"This is unlikely to be the case. We have now solved the key political problems connected with signing the convention. Nevertheless, there remain several matters to attend to: technical difficulties, control over permitted activities, the interests of private companies and transnational corporations, the legal problems involved in verification, and the risk of proliferation of chemical weapons. Overcoming all these barriers will take more time, but we really have reached the final stage..."

Ambassador Robert Van Schaik, the head of the Netherlands delegation and a former coordinator at the talks, cannot be denied imaginative thinking.

"I would compare the trip to Shikhany with reaching the top of the precipice we've been climbing for so long. This does not mean that a plain lies ahead and the going will be easier. There are still several heights to be conquered, but unless we maintain a multilateral exchange of information, we shall be groping in the dark for a long time to come...."

I was particularly interested to know the opinion of the head of the American delegation. Max Friedersdorf told me he was healthily optimistic and promised that his delegation would work for the convention.

Well, let's hope it will. However, the ambassador's words do not quite tally with the fact that just a few days before his arrival in Shikhany, Washington had decided to restart the production of binary chemical weapons as of 1 December 1987. Trying to justify this decision, Mr. Friedersdorf claimed that far from retarding progress towards the convention, the U.S. binary program would even accelerate it.

The rationale behind this move is anybody's guess. Does it imply that the US administration is pessimistic about the outcome of the talks—or, perhaps, about the very possibility of banning and eliminating these barbarous weapons? Or is it meant to test the Soviet position for "stamina?" It is a shame that no sooner had some real progress been made in Geneva than new and considerable obstacles were put in its way. After all, the appearance of binary weapons will enormously complicate one of the key problems—that of control.

I asked Lieutenant General Anatoly Kuntsevich, a leading expert of the USSR Ministry of Defense and corresponding member of the USSR Academy of Sciences, to comment on this decision by Congress.

"The decision challenges the talks now in progress," he said, "at a time when the Soviet Union is doing everything within its power to build confidence in Geneva and to make mankind's cherished dream come true...."

The decision undermines confidence. Against this background, Ronald Reagan's recent call from the UN platform "for greater openness, for freer access to information about the Soviet Union and its armed forces, policies, and programs so that our arms reduction talks can proceed in an atmosphere of greater confidence" sounds hypocritical. Is it good policy to demand confidence form your partner while making moves which compel him to call into question your sincerity and your readiness to sign the convention?

In Shikhany, the word "convention" sounded very frequently. Most people want it signed at the earliest date possible. This involves problems, we admit, but all of them, no matter how serious, lend themselves perfectly to solution as the two days in Shikhany have proved beyond doubt.

/12232

At Military Site in Shikhany

18410093 Moscow KRASNAYA ZVEZDA in Russian 4 Oct 87 p 4

[Article by Lt. Col. V. Baberdin, KRASNAYA ZVEZDA Correspondent, Saratov Oblast]

[Text] Shikhany is the name of a military site directly related to problems in chemical weapons which has riveted the attention of political, social, military, and diplomatic workers.

What has brought on this interest? At this place and at this time, a new approach is taking place to the solution of international problems. Today, one of the steps in the practical work of a delegation of participants in the Geneva Disarmament Talks was transferred here to Shikany. A step which, it is felt, will create favorable conditions for the final stage in developing a convention on outlawing chemical weapons.

One hundred fifty representatives from 45 countries participating in the Geneva Talks — diplomats, military specialists, scientists-experts, journalists — arrived from the observer-nations on the morning of 3 Oct at Bagay-Baranovka airport on a special flight from Moscow.

They were met by the chief of chemical forces, USSR Ministry of Defense, Hero of Soviet Union, Colonel-General V. Pikalov. Later, the chief of the Shikany site, Major General R. Razuvanov familiarized the participants with the layout of the site and showed them a program for the working day.

A demonstration platform for chemical weapon types consists of a well-defined row of exhibits; charts are hung on screens with tactical and technical data — they are duplicated on monitor screens so that television cameras make it possible to view any point. Among the displayed weapons are samples of chemical shells for both barrel and jet propelled artillery, chemical components of tactical rockets, and samples of chemical aerial bombs and chemical spray devices. A chemical hand grenade, a close-combat weapon, is also demonstrated here.

One by one, officers of the site sound off their reports. The information which they report is laconic in form, while at the same time saturated in content. For each weapon a report is given on its military designation, caliber, code, composition of toxicant with which the weapon is charged, method of dispersal, type of detonator, and the structural material used.

The participants are shown the physicochemical characteristics of skin-blistering, nerve-paralyzing, and irritating toxicants.

In any case, the presentation for the specialists is comprehensive.

In the evening, at a briefing, the leading expert of the USSR Ministry of Defense, Hero of Socialist Labor, and corresponding member of the USSR Academy of Sciences, Lieutenant General A. Kuntsevich, in reply to the question of whether or not representations of all weapons of the chemical forces were displayed, stated: all with the exception of similar modified samples which differ insignificantly in design and structural materials. He added further, addressing the representatives of foreign delegations: as you yourselves know, the volume and concrete nature of information presented in the demonstration make it possible for specialists to draw conclusions and obtain a full picture of our system of chemical weapons.

The coworkers of the Shikhany Military Site were also given a demonstration on methods for toxic evaluation of chemical agents, which could be used as a basis for solving particular problems in a future convention. Here also was demonstrated a mobile complex for destroying chemical weapons — an excellent addition to stationary plants, one of which has started construction not far from Chapayevsk in Kuybyshevsk Oblast.

The advantage of the mobile unit lies in the fact that it may be re-located to any site of the chemical forces. The complex is mounted on a highly navigable vehicle and is capable of transport by flat rail cars and on air and sea vessels. It can be assembled in 10 hours and requires 17 men. With its help, it is possible to destroy 19 to 1,500 kg of weapons.

"Technology for the destruction of chemical weapons is calculated in such a manner," stated Lt. Col. P. Nikitayev, pointing to a diagram, "to provide maximum safety to human beings; the process should be closed and ecologically clean. All operations are carried out with a minimum number of service personnel. The toxic agents are neutralized in chambers where a vacuum is maintained so that even if there is an electric power failure or a partial air leak on the part of an operator, there is still time to prevent an accident. Special automatic devices are used to maintain constant control of the contamination of worker's clothing and the conditions of the atmosphere, soil, and vegetation in the region contiguous to the complex.

But just exactly how are the chemical weapons destroyed? Initially, the chemical bomb or shell is placed in a disarming chamber, where the body is unscrewed, and the lethal agent is removed. It is then analyzed with special sensors in a laboratory and then transferred to the "Neutral" unit. Here, the first stage of the conversion process takes place — thermochemical neutralization (at 110-120 degrees C). This leaves non-toxic compounds. It has been calculated that one ton of toxic agent yields not more than two cubic meters of liquid wastes. They are

then placed in the next chamber where they are burned at a higher temperature (1,100-1,200 degrees C). The resulting oxides of carbon, hydrogen fluoride, and water vapor now have concentrations well below the sanitary norm and present no danger to the environment.

The second day for the foreign delegates at the Shikhany military site ended with a demonstration of the complex in action, destroying an aerial bomb charged with sarin. A flight to Moscow is planned for the evening, and tomorrow morning, a press conference will be held on the results of the expedition.

12765

UDC 537.311.33+535.343.2

Study of Dielectric-Superconductor Transition in BEDT-TTF Iodides by Infra-Red Spectroscopy

18410491 Moscow KHIMICHESKAYA FIZIKA in Russian Vol 6, No 6, Jun 87 (manuscript received 14 May 86) pp 760-763

[Article by M.G. Kaplunov, E.B. Yagubskiy, R.P. Shibayeva, and Yu.G. Borodko, Institute of Chemical Physics, Chernogolovka Branch, USSR Academy of Sciences]

[Abstract] Superconductor compounds have been found among bis (ethylenedithio) tetrathiafulvalene iodides (BEDT-TTF or ET), and it has been confirmed recently that partial elimination of iodine from the dielectric epsilon-phase results in the formation of a superconducting beta-phase at a transition temperature of 6-7 K, which is greater than the 1.5 K of the beta-phase obtained directly from ET. The infra-red spectra of organic conductors vary markedly in relation to their conductivity, and the spectra of highly conductive compounds have bands related to intermolecular charge transfer and the interaction of molecules with conductivity electrons. A study of the spectral changes taking place during the transition from poor conductor to superconductor in the case of ET compounds seemed interesting, and for this purpose, reflectivity spectra with polarized light were conducted at room temperature for single crystals in the epsilon-phase and for crystals, formed with varying amounts of iodine elimination, from the epsilon-phase up to the beta-phase. IR-spectra reflect changes in electrical properties that take place during epsilon beta transition, and the spectrum of the superconducting beta-phase has bands related to the presence of conducting electrons, making it possible to evaluate electron transfer parameters such as the transition integral and effective mass of the carrier charge. Figures 2; table 1; references 8: 5 Russian, 3 Western.

12765

END OF
FICHE
DATE FILMED
28 April 1988